(6) Japanese Patent Application Laid-Open No. 2003-143871

(Japanese-English machine translation is attached.)

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-143871
(43)Date of publication of application : 16.05.2003

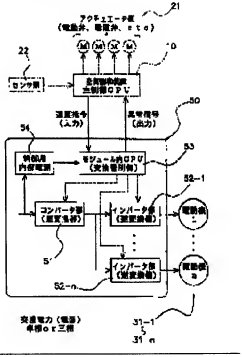
(51)Int.Cl. H02M 7/48
F24F 5/00
F24F 11/02

(21)Application number : 2001-336274
(22)Date of filing : 01.11.2001

(71)Applicant : DAIKIN IND LTD
(72)Inventor : IIDA MASAKAZU
EHIRA SHINJI

(54) MOTOR CONTROL MODULE AND AIR-CONDITIONING APPARATUS THEREWITH

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a motor control module capable of reducing load for inverter design spent for each motor, that is, man-hour for inverter design.
SOLUTION: This motor control module 50 outputs driving waveforms to the respective motors 31-1 to 31-n by inputting AC power, and includes a converter 51, inverters 52-1 to 52-n, and an in-module CPU 53. The converter 51 and the inverters 52-1 to 52-n convert inputted AC power to AC power with an arbitrary frequency. The in-module CPU 53 generates the driving waveforms for driving the motors 31-1 to 31-n and controls the converter 51 and the inverters 52-1 to 52-n.



LEGAL STATUS

[Date of request for examination] 27.09.2004

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It is the motor control module (50) which inputs alternating current power and outputs a drive wave to a motor (31-1 - 31-n). The inverter transducer which changes the alternating current power inputted into the alternating current power of the frequency of arbitration (51, 52-1 - 52-n), The motor control module equipped with inverter control CPU (53) which performs generation of said drive wave and controls said inverter transducer (51, 52-1 - 52-n) (50).
[Claim 2] It has further the 1st substrate (61) and the 2nd substrate (62). Said inverter transducer (51, 52-1 - 52-n) So that it may have two or more power components (71) and the calorific value of said 2nd substrate (62) may become smaller than the calorific value of said 1st substrate (61) It is the motor control module according to claim 1 with which what has big calorific value is mounted in said 1st substrate (61) among said power components (71), and said inverter control CPU (53) is mounted in said 2nd substrate (62) (50).
[Claim 3] Said 1st substrate (61) and said 2nd substrate (62) are a motor control module according to claim 2 arranged at the multilayer (50).
[Claim 4] For said 1st substrate (61), said power component (71) which are thermally conductive high substrates and is mounted in said 1st substrate (61) from said 2nd substrate (62) is a motor control module according to claim 2 or 3 by which bare chip mounting is carried out at said 1st substrate (61) (50).
[Claim 5] Said inverter control CPU (53) is a motor control module given in either of claims 1-4 which has the control network to two or more motors (31-1 - 31-n) of each (50).
[Claim 6] Said inverter transducer (51, 52-1 - 52-n) The converter section which changes the alternating current power inputted into direct current power (51), It has two or more inverter sections (52-1 - 52-n) which change said direct current power into the alternating current power of the frequency of arbitration. Said inverter control CPU (53) The motor control module according to claim 5 which controls said converter section (51) and said two or more inverter sections (52-1 - 52-n), and outputs a drive wave to two or more motors (31-1 - 31-n) (50).
[Claim 7] The motor control module according to claim 6 further equipped with the internal electrical power source (54) for said inverter control CPU (53) generated from the direct current power changed by the alternating current power inputted or said converter section (51) (50).
[Claim 8] Said inverter control CPU (53) is a motor control module given in either of claims 1-7 which inputs the command about the operating power of a motor (31-1 - 31-n) from the outside, and outputs an abnormality signal outside (50).
[Claim 9] Said inverter control CPU (53) is a motor control module according to claim 8 which has the distinction function whether the interior is unusual or the exterior is unusual, and includes the information on whether the interior of said abnormality signal is unusual, or the exterior is unusual (50).
[Claim 10] Said inverter control CPU (53) is a motor control module according to claim 9 which performs protection control which protects the interior when the interior is unusual, and outputs the contents of the internal abnormalities outside (50).
[Claim 11] A motor control module given in either of claims 1-10 which was further equipped with the electric fan for cooling said inverter transducer (51, 52-1 - 52-n) and said inverter control CPU (53) (50).
[Claim 12] At least one fan motor made to rotate an outdoor fan (31-2), The main control CPU which emits the drive command to a compressor (31-1), and said fan motor (31-2) and said compressor (31-1) (10) The drive command from said main control CPU (10) is inputted by said inverter control CPU (53). The conditioner which equipped with the motor control module (50) of a publication either of claims 1-11 which output the drive wave according to said drive command to said fan motor (31-2) and said compressor (31-1) (1).

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the air conditioning system equipped with the air conditioning system equipped with a motor control module and it, the motor control module for carrying out inverter control of the motor especially, and it.
[0002]
[Description of the Prior Art] Recently as an approach of driving the motor of a motor etc., the method of using an inverter is becoming in use. Since an inverter can adjust the output of a motor by controlling the clock frequency of a motor free, it is a very dominance technique from a viewpoint of energy saving. This inverter is a motor control section which controls and drives a motor, and consists of two or more components containing IGBT, a main circuit component (inverter module) called IPM.
[0003] As a basic configuration of an inverter, the converter section which rectifies a commercial alternating current power source to a direct current, the inverter section which changes direct current power into the alternating current power of the frequency of arbitration, the control section which controls these power conversion sections are mentioned.
[0004]
[Problem(s) to be Solved by the Invention] An inverter has many heating values concentrated on the semiconductor chip to be used, and since many components complicated [a control circuit] and fine are used, the design is very difficult for it, and it has required time amount. In the former, the individual separate installation meter of the hard part of an inverter is carried out for every target motor about the design of such an inverter. Specifically, the designer is selecting control power, the drive circuit, the main circuit, etc. whenever [the] to the motor different from an old thing. Moreover, also about the software part (software of an inverter drive) of the inverter arranged on an external microcomputer etc., an individual separate installation meter is performed for every motor, exclusive software is created, and it succeeds in the matching trial with a motor.
[0005] Furthermore, about the thermal design of the hard part of an inverter, since the structural design in consideration of a wind etc. is involved, many engineers are mobilized for every motor and design development is performed. The technical problem of this invention is to offer the load to the inverter design spent for every motor, i.e., the motor control module which can reduce the design man day of an inverter.
[0006]
[Means for Solving the Problem] The motor control module concerning claim 1 inputs alternating current power, outputs a drive wave to a motor, and is equipped with the inverter transducer and inverter control CPU. An inverter transducer changes the alternating current power inputted into the alternating current power of the frequency of arbitration. Inverter control CPU performs generation of a drive wave for driving a motor, and controls an inverter transducer.
[0007] Here, a motor control section with the function which inputs alternating current power and outputs a drive wave by incorporating the inverter transducer which changes power, and inverter control CPU which controls it into one module can be dealt with now as one component (module). For this reason, the individual separate installation meter of the inverter currently conventionally performed for every motor becomes in general unnecessary, and the design man day of an inverter can be sharply reduced now.
[0008] Moreover, if this motor control module is used, in order to carry out to generation of a drive wave in inverter control CPU in a module, the load concerning Exterior CPU etc. decreases very much. Furthermore, since CPU of dedication is allotted in the module, it excels in high-speed responsibility and control of a motor comes to be stabilized. In addition, as for inverter control CPU, it is desirable to consider as the general-purpose thing which can respond to the motor of a different class. In this case, a motor control module can be used now in the still larger range as components which mitigate the load of the inverter design according to individual.

[0009] The motor control module concerning claim 2 is a motor control module according to claim 1, and is further equipped with the 1st substrate and the 2nd substrate. The inverter transducer has two or more power components. Moreover, what has big calorific value is mounted in the 1st substrate among power components so that the calorific value of the 2nd substrate may become smaller than the calorific value of the 1st substrate. On the other hand, inverter control CPU is mounted in the 2nd substrate. Power components mean components, such as a semiconductor device which can deal with power several W or more, and diode, a fixed resistor.
[0010] He usually mounts in the 1st substrate what has big calorific value among the power components of the inverter transducer accompanied by generation of heat, and is trying for the calorific value of the 2nd substrate to become smaller than the calorific value of the 1st substrate here. And CPU which generally dislikes heat is mounted in the 2nd substrate. It becomes possible to miniaturize the whole module, suppressing the effect of the heat which inverter control CPU in a module receives by this.
[0011] In addition, in the thermal design of this motor control module, if even required airflow is applied, it is desirable for all the components in a module to enable it to acquire the desired cooling effect. The motor control module concerning claim 3 is a motor control module according to claim 2, and the 1st substrate and the 2nd substrate are arranged at the multilayer.
[0012] In the motor control module of claim 2, the 2nd substrate smaller than the 1st substrate is adopted, and standing the 2nd substrate to the 1st substrate, or floating the 2nd substrate by an exclusive pin etc. from the 1st substrate is also considered. On the other hand, in the motor control module of claim 3, the 1st substrate and the 2nd substrate are arranged to the multilayer. Although the inclination for the microcomputer of various functions and many outputs to be needed is strong and is in the inclination for circumference components to also increase in number according to it, in inverter control, since the 1st substrate and the 2nd substrate are arranged to the multilayer, it becomes possible with the motor control module of claim 3 to use many outputs and mass inverter control CPU. Thus, if many outputs and adoption of mass inverter control CPU are attained, since inverter control CPU which can respond to various motors can be incorporated in a module, the motor control module as components can be used by the inverter design of the larger range.
[0013] Moreover, the effectiveness that a floor space (superficial size) required for installation of a motor control module becomes small can also be acquired by multilayer arrangement of two or more substrates. The motor control module concerning claim 4 is a motor control module according to claim 2 or 3, and the 1st substrate is a substrate with thermal conductivity higher than the 2nd substrate. Moreover, bare chip mounting of the power components mounted in the 1st substrate is carried out by the bonding wire etc. at the 1st substrate.
[0014] Here, the 1st substrate was made [thermally conductive] better than the 2nd substrate, and the configuration which carries out bare chip mounting of the power components at the 1st substrate is taken. For this reason, the heat by generation of heat of power components comes to radiate heat efficiently through the 1st substrate. When using the usual printed circuit board for the 2nd substrate, it is possible to use the substrate which set the aluminum plate by the aluminum substrate, the alumina substrate, and the ceramic plate as the 1st substrate. Such 1st substrate functions as an efficient heat sink.
[0015] In addition, when a radiation fin is prepared in the 1st substrate, higher heat dissipation nature can be obtained. The motor control module concerning claim 5 is a motor control module given in either of claims 1-4, and inverter control CPU has the control network to two or more motors of each.
[0016] Here, since the control network to two or more motors is given to inverter control CPU, correspondence of a motor control module is attained also at the concurrency control of two or more motors. Moreover, the use range of a motor control module becomes large as components which can control the drive of various motors. In addition, since the interior is equipped with inverter control CPU of dedication in the motor control module of this invention, it is easy to make the CPU itself generous and it is possible to give two or more control networks to inverter control CPU.
[0017] Moreover, inverter control CPU means giving the information (information that duty is decided how to compensate for the wave for driving each motor, or a drive command etc.) corresponding to [having two or more control networks] two or more motors of each, into inverter control CPU. The motor control module concerning claim 6 is a motor control module according to claim 5, and the inverter transducer has the converter section and two or more inverter sections. The converter section changes the alternating current power inputted into direct current power. The inverter section changes direct current power into the alternating current power of the frequency of arbitration. Moreover, inverter control CPU controls the converter section and two or more inverter sections, and outputs a drive wave to two or more motors.
[0018] Here, the alternating current power of the frequency suitable for the drive wave by which two or more inverter sections of each were generated to the predetermined motor is generated. Therefore, it is possible to perform concurrency control of two or more motors with the motor control module which is one component. The

motor control module concerning claim 7 is a motor control module according to claim 6, and is further equipped with the internal electrical power source. An internal electrical power source is a power source for inverter control CPU, and is generated from the direct current power changed by the alternating current power or the converter section inputted.

[0019] Thus, by incorporating an internal electrical power source in a module, the components which it becomes unnecessary to put the power source of dedication on the modular exterior, and are arranged outside can be reduced. In addition, about the motor control module of invention concerning claim 7, the configuration which carries out the external input of the power source (power) for driving inverter control CPU in a module can also be taken. Also in this case, since it is convertible for desired two or more power sources with an internal electrical power source, the power source inputted from the outside becomes good with a single power source, and the components arranged outside can be reduced.

[0020] The motor control module concerning claim 8 is a motor control module given in either of claims 1-7, and inverter control CPU inputs the command about the operating power of a motor from the outside, and outputs an abnormality signal outside. Here, if the command about the operating power of a motor is inputted by an analog or a digital signal input from the outside by Exterior CPU (external microcomputer) etc., a motor control module will generate a drive wave according to the command, and will output it to a motor. Moreover, when abnormal, an abnormality signal is outputted outside. Thus, in order that a motor control module may perform generation and abnormality distinction of a drive wave, the load concerning Exterior CPU etc. becomes very small, and design man days, such as Exterior CPU, will be greatly reduced compared with the former.

[0021] In addition, when an abnormality signal is outputted from a motor control module, it is thought that Exterior CPU etc. is designed so that the measure according to it may be taken. For example, the main control CPU of a conditioner is Exterior CPU, and if an abnormality signal is outputted from a motor control module to main control CPU when using the motor control module of claim 8 as electronic autoparts which perform drive control of the fan motor of an exterior unit, and a compressor, taking the measure of main control CPU stopping a conditioner will be expected.

[0022] The motor control module concerning claim 9 is a motor control module according to claim 8, and it has the distinction function whether the interior of inverter control CPU is unusual, or the exterior is unusual. Moreover, the abnormality signal outputted outside from inverter control CPU includes the information on whether the interior is unusual or the exterior is unusual, i.e., the information whether abnormalities occurred externally whether abnormalities occurred inside the motor control module.

[0023] Here, the exterior CPU where an abnormality signal is outputted can acquire now existence of abnormalities and the information of the abnormalities inside a motor control module, or the abnormalities of the motor control-module exterior from a motor control module. Therefore, when Exterior CPU etc. stores those information, pinpointing of the abnormality part at the time of repair of components etc. becomes easy, and can lessen a substitute part.

[0024] The motor control module concerning claim 10 is a motor control module according to claim 9, and inverter control CPU performs protection control which protects the interior, when the interior is unusual, and it outputs the contents of the internal abnormalities outside. Here, in order to perform protection control of internal protection of inverter control CPU at the time of internal abnormalities, the load concerning Exterior CPU etc. decreases more.

[0025] The motor control module concerning claim 11 is a motor control module given in either of claims 1-10, and is further equipped with the electric fan for cooling an inverter transducer and inverter control CPU. Here, since the electric fan of the dedication for cooling the inverter transducer and inverter control CPU in a module is incorporated, as for a motor control module, the degree of freedom of the installation increases. That is, since sufficient cooling effect can be acquired by the electric fan of dedication even if it does not use the wind generated by the external fan etc., it becomes possible to install a motor control module in the location of arbitration.

[0026] The conditioner concerning claim 12 is equipped with at least one fan motor made to rotate an outdoor fan, compressor, and main control CPU and a motor control module given in either of claims 1-11. Main control CPU emits the drive command to a fan motor and a compressor. A motor control module inputs the drive command from main control CPU by inverter control CPU, and outputs the drive wave according to a drive command to a fan motor and a compressor.

[0027] Here, a motor control module outputs the drive wave corresponding the drive command of the fan motor and compressor which are a motor to the drive command to reception, a fan motor, and a compressor from the main control CPU which controls the whole conditioner. And inverter control CPU is included in the interior of a motor control module, and in order that the inverter control CPU may perform generation of a drive wave, the load applied to main control CPU about the drive of a fan motor and a compressor decreases very much. For

this reason, the software design of the main control CPU about the inverter control of a fan motor or a compressor is mitigated, and a design man day is reduced sharply.

[0028]

[Embodiment of the Invention] The motor control module applied to 1 operation gestalt of this invention used for drawing 1 with the conditioner in the conditioner concerning 1 operation gestalt of <outline configuration of conditioner> this invention is shown in drawing 2 . The conditioner 1 consists of 4, such as refrigerant piping which connects both 2 and 3 to the interior unit 2 attached indoors and the exterior unit 3 installed in outdoor. A blower fan, indoor heat exchanger, etc. are arranged inside the interior unit 2. Inside the exterior unit 3, the outdoor fan who rotates with a compressor and a fan motor, the outdoor heat exchanger, etc. are arranged. Refrigerant piping connects the indoor heat exchanger in an interior unit 2, and the outdoor heat exchanger in an exterior unit 3, and constitutes the refrigerant circuit with each heat exchanger.

[0029] <Outline control configuration of conditioner> drawing 2 is the block diagram showing the outline of a power circuit in which it is used for a conditioner 1, and is expressed centering on the motor control module 50 which is arranged in an exterior unit 3 and which was elegance-ized the part. The main control CPU 10 prepared in order to control the whole conditioner 1 has ROM and the various interfaces which are not illustrated, receives the detecting signal from sensors 22, controls actuators 21, takes out a rate command to the motor control module 50, and makes the compressor 31-1 and fan motor 31-2 of an exterior unit 3 drive. The heat exchanger thermistor which detects the evaporation temperature and condensation temperature of an open air thermistor and a heat exchanger which detect outside air temperature as sensors 22, the discharge-tube temperature sensor which detects the discharge-tube temperature of a compressor, the discharge-pressure sensor which detects the discharge side and inlet-side pressure of a compressor, a suction pressure sensor, etc. are mentioned. Moreover, the 4 way change-over valve for switching the operation mode of the electric expansion valve for being arranged in a refrigerant circuit and decompressing an internal refrigerant as actuators 21, and a refrigerant circuit etc. is mentioned. In addition, an electric power supply is carried out to main control CPU 10 from the switching power supply (control power source) connected to the commercial alternating current power source.

[0030] The <basic configuration of motor control module> motor control module 50 controls the supply voltage for driving two or more motors 31-1 - 31-n according to the operation situation of a conditioner 1. Specifically in this air conditioning system 1, the motor control module 50 controls the alternating current power which has a predetermined drive wave for driving the compressor 31-1 and fan motor 31-2 in an exterior unit 3 according to the rate command from main control CPU 10. Although the modularization of this motor control module 50 is carried out so that a part can be dealt with as elegance, it contains CPU53 of dedication in that interior. Specifically, the inside CPU 53 of the converter section 51, two or more inverter sections 52-1 - 52-n, and a module and an internal electrical power source 54 are components-ized as one module.

[0031] The converter section 51 rectifies the alternating current power of the single phase inputted into the motor control module 50, or a three phase, and changes it into a direct current. The converter section 51 can be considered as the configuration which used the power switch, and can also be considered as a configuration including the active filter circuit which outputs a direct current of a fixed electrical potential difference to the inverter section 52-1 - 52-n.

[0032] Two or more inverter sections 52-1 - 52-n change the output (direct current) of the converter section 51 into the alternating current of the frequency of arbitration, and output it to a motor 31-1 - 31-n, respectively. Here, in order to use the motor control module 50 for drive control of a compressor 31-1 and a fan motor 31-2, it has composition in which the inverter section 52-1 outputs alternating current power to a compressor 31-1, and the inverter section 52-2 outputs alternating current power to a fan motor 31-2.

[0033] The inside CPU 53 of a module consists of one chip microcomputers including a microprocessor, ROM, various interfaces, etc. The inside CPU 53 of this module has the control network to two or more motors 31-1 - 31-n. The information that duty is specifically decided how to compensate for the rate command from the drive wave for driving each motor or main control CPU 10 etc. is incorporated in [CPU / 53] the module. Thereby, the inside CPU 53 of a module can generate a drive wave now to a motor 31-1 - 31-n based on the rate command from main control CPU 10. In addition, although the control network corresponding to a compressor 31-1 and a fan motor 31-2 is incorporated in [CPU / 53] the module at least in the motor control module 50 used with an air conditioning system 1, it is also possible to give the control network of two or more kinds of motors (an AC motor, a stepping DC motor, sensor loess DC motor, etc.) to the motor control module 50. With such a module, it also becomes possible to drive to coincidence the motor of a class by which many differ. Moreover, it is not based on the class of motor to be used, but the same components (module) can be used now.

[0034] Moreover, the inside CPU 53 of a module has the abnormality signal output function which outputs the

protection feature which protects the interior of a module 50, and an abnormality signal including the contents of the abnormalities outside (main control CPU 10), when the interior of the distinction function of whether the caused abnormalities are internal abnormalities (abnormalities in a module) or to be external abnormalities (abnormalities besides a module) and abnormalities is unusual. Main control CPU 10 receives the abnormality signal outputted out of [CPU / 53] a module, and it takes the measure of stopping a conditioner 1 while it stores abnormality information and gives the facilities in repair of components etc., and exchange.

[0035] An internal electrical power source 54 is an exclusive power source of the sake in [CPU / 53] a module, and is generated from the commercial alternating current power inputted into the motor control module 50.

In the <detail configuration of motor control module> motor control module 50, a controllability is made to improve passive circuit elements accumulation and by carrying out a modularization and package-izing exoergic components and noise-source components, and it makes it possible to make highly efficient control perform.

[0036] As shown in drawing 3 , the printed circuit board (multilayer arrangement was carried out) 62 and the aluminum substrate 61 which have been arranged in parallel up and down are equipped with the electrical part in the motor control module 50. Moreover, wiring of the up-and-down printed circuit board 62 and the aluminum substrate 61 is connected by the cable run plate 63 by which resin mold was carried out. Since the inside CPU 53 of the module which consists of one chip microcomputers including a microprocessor, ROM, various interfaces, etc. is what should be intercepted from generation of heat and the noise by other electrical parts, the printed circuit board 62 which is not equipped with what has big calorific value among the power components 71 is equipped with it. Moreover, the printed circuit board 62 is equipped also with the control-section article without generation of heat (or few).

[0037] On the other hand, in the motor control module 50, bare chip mounting of the power components 71 (what deals with power about tenW or more), such as diode and a power transistor, is altogether carried out at the aluminum substrate 61 among the components which constitute the converter section 51, the inverter section 52-1 - 52-n. Thus, since it constitutes so that bare chip mounting of all the things that have large calorific value may be carried out with the wirebonding wire 73 etc. among the power components 71 at the aluminum substrate 61, the calorific value of a printed circuit board 62 is smaller than the calorific value of the aluminum substrate 61, and the effect of the high heat and noise to the CPU53 grade in a module of a printed circuit board 62 is suppressed.

[0038] In addition, that on which thermal conductivity stuck the sheet metal of the copper which constitutes a circuit pattern on the front face of the good high alumimium nitride plate of electric insulation is used for the aluminum substrate 61. As mentioned above, finally the aluminum substrate 61 with which bare chip mounting of the power components 71 was carried out on the component side is covered by the mold material 81. The mold material 81 is a wrap about the power components 71 or the components on a bonding wire 73 and the other aluminum substrates 61, as shown in drawing 4 (a). The mold material 81 consists of insulating synthetic resin, such as silicon system resin and resin of an epoxy system. This mold material 81 has the function to which diffusion heat transfer of the heat which the power components 71 emit is carried out, and raises the cooling effect of the motor control module 50. Moreover, by covering power components 71 grade by the mold material 81, the components in a module 50 can be protected now from **** or moisture, and the degree of freedom of arrangement of the motor control module 50 increases. It becomes possible to specifically arrange the motor control module 50 on the ventilation tooth space of the exterior unit 3 with which many moisture and dust exist instead of the inside of the machine room of an exterior unit 3.

[0039] In addition, putting mold material among the power components 71 only at the place of a bonding wire 73 is also considered instead of putting the mold material 81 on the aluminum substrate 61, as shown in drawing 4 (a). Moreover, as shown in drawing 4 (b), it is possible to cover by the mold material 81 not only about the components on the aluminum substrate 61 but about the components on a printed circuit board 62.

[0040] Thus, it is possible by taking wrap structure for the main parts of the motor control module 50 by the mold material 81 to perform the thermal design of the motor control module 50, taking the wind by the outdoor fan of an exterior unit 3 into count. In fact, if even required airflow is applied to a module 50, it succeeds in the thermal design of the motor control module 50 so that all the components in a module 50 may be cooled to the level which does not have trouble in actuation.

[0041] The <control of compressor and fan motor> main control CPU 10 transmits the controlled variable of a compressor 31-1 and a fan motor 31-2 to CPU53 in the motor control module 50 in the form of a rotational-speed command signal while it determines the controlled variable of each part and outputs a control value to actuators 21 according to the detection value inputted from sensors 22, and current operation mode.

[0042] Within [CPU / 53] a module, the drive wave of a compressor 31-1 and a fan motor 31-2 is generated based on the rotational-speed command signal (rate command) transmitted from main control CPU 10. And CPU53 controls the converter section 51 and the inverter section 52-1, and 52-2, and makes the drive wave

which suited the rate command from main control CPU 10 output to a compressor 31-1 and a fan motor 31-2. The alternating current power which has a predetermined frequency to a compressor 31-1 and a fan motor 31-2 is supplied from the inverter section 52-1 and 52-2 by this, and a compressor 31-1 and a fan motor 31-2 drive as the rate command of main control CPU 10.

[0043] In the <description of motor control module of this operation gestalt> (1) motor control module 50 By incorporating into one module, the converter section 51 and the inverter section 52-1 - 52-n which change commercial alternating current power into the alternating current power of the frequency of arbitration, and CPU53 which controls them A motor control section with the function which inputs commercial alternating current power and outputs a drive wave can be dealt with now as one component (module). For this reason, the individual separate installation meter of the inverter currently conventionally performed for every motor becomes unnecessary, and the design man day of an inverter can be reduced sharply.

[0044] Moreover, if this motor control module 50 is used, since it has composition performed to generation of a drive wave in [CPU / 53] a module, the load concerning main control CPU 10 decreases very much. Furthermore, since CPU53 of dedication is allotted in the module 50, it excels in high-speed responsibility and control of a motor 31-1 - 31-n comes to be stabilized more.

[0045] (2) In the motor control module 50, mount the main power components 71 (all the power components that can deal with power at least about tenW or more) accompanied by generation of heat in the aluminum substrate 61 which is excellent in heat dissipation nature after taking the multilayer structure of the aluminum substrate 61 and a printed circuit board 62, and mount the CPU53 grade which dislikes heat in a printed circuit board 62. The module 50 whole can be miniaturized this suppressing the effect of the heat which the inside CPU 53 of a module receives. Moreover, what has big calorific value is brought together in the aluminum substrate 61 among the power components 71, and the motor control module 50 has come to be able to perform stable control by arranging components with small calorific value (they being [as opposed to / especially / the property] the high components of temperature dependence) to a printed circuit board 62.

[0046] (3) In a motor control module, the printed circuit board 62 smaller than the aluminum substrate 61 is adopted, and standing a printed circuit board 62 to the aluminum substrate 61, or floating a printed circuit board 62 by a bonding wire etc. from the aluminum substrate 61 is also considered.

[0047] On the other hand, in the motor control module 50 of this operation gestalt, the configuration which arranges the aluminum substrate 61 and a printed circuit board 62 to a multilayer is taken, a printed circuit board 62 can be enlarged, and it is possible to use the inside CPU 53 of large capacity and a various functions module. For this reason, it can be incorporated in the motor control module 50, being able to use as the inside CPU 53 of a module mass and multifunctional CPU which can respond to various motors, and the motor control module 50 as components can use it now in the inverter design of the larger range.

[0048] Moreover, the effectiveness that an area required for installation of the motor control module 50 becomes small has been acquired by multilayer arrangement of two or more substrates 61 and 62.

(4) In the motor control module 50, the configuration which carries out bare chip mounting of the power components 71 at the aluminum substrate 61 is taken by using as the aluminum substrate 61 the substrate with which what has big calorific value is mounted among the power components 71. Since this aluminum substrate 61 functions as an efficient heat sink, the heat by generation of heat of the power components 71 radiates heat efficiently through the aluminum substrate 61.

[0049] (5) In the motor control module 50, since the control network to two or more motors 31-1 - 31-n is given in [CPU / 53] a module, it can respond also to the concurrency control of two or more motors 31-1 - 31-n. Moreover, the use range of the motor control module 50 is wide as components which can control the drive of the various motors 31-1 - 31-n.

[0050] (6) In the motor control module 50, the internal electrical power source 54 is incorporated in the module 50. For this reason, it is unnecessary to put the power source of dedication on the exterior of a module 50, and use is further easy to carry out the motor control module 50 on a design.

(7) If it succeeds in the input of a rate command from main control CPU 10, the motor control module 50 will generate a drive wave according to the command, and will output it to a motor. Moreover, when abnormal, after performing abnormality distinction, an abnormality signal is outputted to main control CPU 10. Thus, in order that the motor control module 50 may perform generation and abnormality distinction of a drive wave, the load concerning main control CPU 10 becomes very small, and the design man day of main control CPU 10 is greatly reduced compared with the former.

[0051] In order to heighten the heat dissipation effectiveness of the operation gestalt >(A) aluminum substrate 61 besides <, it is also possible to take the structure which set up the radiation fin to the rear-face side of the component side of the aluminum substrate 61. In case a radiation fin creates the alumimium nitride plate which constitutes the aluminum substrate 61, it can really be formed in coincidence by molding. Moreover, you may

make it fix a radiation fin to the aluminum substrate 61 separately by heat joining, adhesion, etc.
[0052] (B) Although the motors used as a controlled system are a compressor 31-1 and a fan motor 31-2 and being explained supposing the two inverter sections 52-1 and the motor control module 50 which has 52-2 inside, the motor control module which becomes controllable [much more motors] can also be made from the above-mentioned operation gestalt. In this case, while many control networks are inputted in [CPU] a module, the number of the inverter sections (n) will increase.
[0053] For example, when the exterior unit is equipped with two outdoor fans, while putting in the control network about a compressor and two fan motors in [CPU] the module, the three inverter sections will be arranged in a module 50.
(C) Although the internal electrical power source 54 is generated from the alternating current power inputted into the module 50 in the motor control module 50 of the above-mentioned operation gestalt (refer to drawing 2), as shown in drawing 5 , an internal electrical power source 54 is also generable from the power rectified by the direct current by the converter section 51.
[0054] (D) Adding the electric fan for cooling to the motor control module 50 of the above-mentioned operation gestalt further is also considered. If the cooling fan of dedication is built into the motor control module 50, the degree of freedom of the installation of the motor control module 50 will increase. That is, since sufficient cooling effect can be acquired by the electric fan of dedication even if it does not use the wind generated by the external fan etc., it becomes possible to install the motor control module 50 in the location of arbitration.
[0055] (E) Although the aluminum substrate 61 is adopted with the above-mentioned operation gestalt, it can replace with this and the alumina substrate which is excellent in heat dissipation nature similarly, the substrate which set the aluminum plate by the ceramic plate can also be adopted.
[0056]
[Effect of the Invention] With the motor control module concerning claim 1, the inverter transducer which changes power, and inverter control CPU which controls it by incorporating into one module Since a motor control section with the function which inputs alternating current power and outputs a drive wave can be dealt with now as one component (module), The individual separate installation meter of the inverter currently conventionally performed for every motor becomes in general unnecessary, and the design man day of an inverter can be sharply reduced now.
[0057] Moreover, if this motor control module is used, in order to carry out to generation of a drive wave in inverter control CPU in a module, the load concerning Exterior CPU etc. decreases very much. Furthermore, since CPU of dedication is allotted in the module, it excels in high-speed responsibility and control of a motor comes to be stabilized. He usually mounts in the 1st substrate what has big calorific value among the power components of the inverter transducer accompanied by generation of heat, and is trying for the calorific value of the 2nd substrate to become smaller than the calorific value of the 1st substrate in the motor control module concerning claim 2. And CPU which generally dislikes heat is mounted in the 2nd substrate. It becomes possible to miniaturize the whole module, suppressing the effect of the heat which inverter control CPU in a module receives by this.
[0058] With the motor control module concerning claim 3, many outputs and adoption of mass inverter control CPU are attained, and since inverter control CPU which can respond to various motors can be incorporated now in a module, the motor control module as components can be used by the inverter design of the larger range. Moreover, the effectiveness that an area required for installation of a motor control module becomes small can also be acquired by multilayer arrangement of two or more substrates.
[0059] In the motor control module concerning claim 4, the 1st substrate is made [thermally conductive] better than the 2nd substrate, and since the configuration which carries out bare chip mounting of the power components at the 1st substrate is taken, the heat by generation of heat of power components comes to radiate heat efficiently through the 1st substrate. In the motor control module concerning claim 5, since the control network to two or more motors is given to inverter control CPU, correspondence of a motor control module is attained also at the concurrency control of two or more motors. Moreover, the use range of a motor control module becomes large as components which can control the drive of various motors.
[0060] Since the alternating current power of the frequency which suited the drive wave by which two or more inverter sections of each were generated to the predetermined motor in the motor control module concerning claim 6 is generated, it is possible to perform concurrency control of two or more motors with the motor control module which is one component. In the motor control module concerning claim 7, the components which it becomes unnecessary to put the power source of dedication on the modular exterior, and are arranged outside can be reduced by incorporating an internal electrical power source in a module.
[0061] In the motor control module concerning claim 8, in order that a motor control module may perform generation and abnormality distinction of a drive wave, the load concerning Exterior CPU etc. becomes very

small, and design man days, such as Exterior CPU, will be greatly reduced compared with the former. In the motor control module concerning claim 9, the exterior CPU where an abnormality signal is outputted can acquire now existence of abnormalities and the information of the abnormalities inside a motor control module, or the abnormalities of the motor control-module exterior from a motor control module. Therefore, when Exterior CPU etc. stores those information, pinpointing of the abnormality part at the time of repair of components etc. becomes easy, and can lessen a substitute part.

[0062] In the motor control module concerning claim 10, in order to perform protection control of internal protection of inverter control CPU at the time of internal abnormalities, the load concerning Exterior CPU etc. decreases more. In the motor control module concerning claim 11, since the electric fan of the dedication for cooling the inverter transducer and inverter control CPU in a module is incorporated, as for a motor control module, the degree of freedom of the installation increases.

[0063] In the air conditioning system concerning claim 12, a motor control module outputs the drive wave corresponding the drive command of the fan motor and compressor which are a motor to the drive command to reception, a fan motor, and a compressor from the main control CPU which controls the whole air conditioning system. And inverter control CPU is included in the interior of a motor control module, and in order that the inverter control CPU may perform generation of a drive wave, the load applied to main control CPU about the drive of a fan motor and a compressor decreases very much. For this reason, the software design of the main control CPU about the inverter control of a fan motor or a compressor is mitigated, and a design man day is reduced sharply.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the air conditioning system equipped with the air conditioning system equipped with a motor control module and it, the motor control module for carrying out inverter control of the motor especially, and it.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] Recently as an approach of driving the motor of a motor etc., the method of using an inverter is becoming in use. Since an inverter can adjust the output of a motor by controlling the clock frequency of a motor free, it is a very dominance technique from a viewpoint of energy saving. This inverter is a motor control section which controls and drives a motor, and consists of two or more components containing IGBT, a main circuit component (inverter module) called IPM.
[0003] As a basic configuration of an inverter, the converter section which rectifies a commercial alternating current power source to a direct current, the inverter section which changes direct current power into the alternating current power of the frequency of arbitration, the control section which controls these power conversion sections are mentioned.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] With the motor control module concerning claim 1, the inverter transducer which changes power, and inverter control CPU which controls it by incorporating into one module Since a motor control section with the function which inputs alternating current power and outputs a drive wave can be dealt with now as one component (module), The individual separate installation meter of the inverter currently conventionally performed for every motor becomes in general unnecessary, and the design man day of an inverter can be sharply reduced now.

[0057] Moreover, if this motor control module is used, in order to carry out to generation of a drive wave in inverter control CPU in a module, the load concerning Exterior CPU etc. decreases very much. Furthermore, since CPU of dedication is allotted in the module, it excels in high-speed responsibility and control of a motor comes to be stabilized. He usually mounts in the 1st substrate what has big calorific value among the power components of the inverter transducer accompanied by generation of heat, and is trying for the calorific value of the 2nd substrate to become smaller than the calorific value of the 1st substrate in the motor control module concerning claim 2. And CPU which generally dislikes heat is mounted in the 2nd substrate. It becomes possible to miniaturize the whole module, suppressing the effect of the heat which inverter control CPU in a module receives by this.

[0058] With the motor control module concerning claim 3, many outputs and adoption of mass inverter control CPU are attained, and since inverter control CPU which can respond to various motors can be incorporated now in a module, the motor control module as components can be used by the inverter design of the larger range. Moreover, the effectiveness that an area required for installation of a motor control module becomes small can also be acquired by multilayer arrangement of two or more substrates.

[0059] In the motor control module concerning claim 4, the 1st substrate is made [thermally conductive] better than the 2nd substrate, and since the configuration which carries out bare chip mounting of the power components at the 1st substrate is taken, the heat by generation of heat of power components comes to radiate heat efficiently through the 1st substrate. In the motor control module concerning claim 5, since the control network to two or more motors is given to inverter control CPU, correspondence of a motor control module is attained also at the concurrency control of two or more motors. Moreover, the use range of a motor control module becomes large as components which can control the drive of various motors.

[0060] Since the alternating current power of the frequency which suited the drive wave by which two or more inverter sections of each were generated to the predetermined motor in the motor control module concerning claim 6 is generated, it is possible to perform concurrency control of two or more motors with the motor control module which is one component. In the motor control module concerning claim 7, the components which it becomes unnecessary to put the power source of dedication on the modular exterior, and are arranged outside can be reduced by incorporating an internal electrical power source in a module.

[0061] In the motor control module concerning claim 8, in order that a motor control module may perform generation and abnormality distinction of a drive wave, the load concerning Exterior CPU etc. becomes very small, and design man days, such as Exterior CPU, will be greatly reduced compared with the former. In the motor control module concerning claim 9, the exterior CPU where an abnormality signal is outputted can acquire now existence of abnormalities and the information of the abnormalities inside a motor control module, or the abnormalities of the motor control-module exterior from a motor control module. Therefore, when Exterior CPU etc. stores those information, pinpointing of the abnormality part at the time of repair of components etc. becomes easy, and can lessen a substitute part.

[0062] In the motor control module concerning claim 10, in order to perform protection control of internal protection of inverter control CPU at the time of internal abnormalities, the load concerning Exterior CPU etc. decreases more. In the motor control module concerning claim 11, since the electric fan of the dedication for cooling the inverter transducer and inverter control CPU in a module is incorporated, as for a motor control

module, the degree of freedom of the installation increases.

[0063] In the air conditioning system concerning claim 12, a motor control module outputs the drive wave corresponding the drive command of the fan motor and compressor which are a motor to the drive command to reception, a fan motor, and a compressor from the main control CPU which controls the whole air conditioning system. And inverter control CPU is included in the interior of a motor control module, and in order that the inverter control CPU may perform generation of a drive wave, the load applied to main control CPU about the drive of a fan motor and a compressor decreases very much. For this reason, the software design of the main control CPU about the inverter control of a fan motor or a compressor is mitigated, and a design man day is reduced sharply.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] An inverter has many heating values concentrated on the semiconductor chip to be used, and since many components complicated [a control circuit] and fine are used, the design is very difficult for it, and it has required time amount. In the former, the individual separate installation meter of the hard part of an inverter is carried out for every target motor about the design of such an inverter. Specifically, the designer is selecting control power, the drive circuit, the main circuit, etc. whenever [the] to the motor different from an old thing. Moreover, also about the software part (software of an inverter drive) of the inverter arranged on an external microcomputer etc., an individual separate installation meter is performed for every motor, exclusive software is created, and it succeeds in the matching trial with a motor. [0005] Furthermore, about the thermal design of the hard part of an inverter, since the structural design in consideration of a wind etc. is involved, many engineers are mobilized for every motor and design development is performed. The technical problem of this invention is to offer the load to the inverter design spent for every motor, i.e., the motor control module which can reduce the design man day of an inverter.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] The motor control module concerning claim 1 inputs alternating current power, outputs a drive wave to a motor, and is equipped with the inverter transducer and inverter control CPU. An inverter transducer changes the alternating current power inputted into the alternating current power of the frequency of arbitration. Inverter control CPU performs generation of a drive wave for driving a motor, and controls an inverter transducer.
[0007] Here, a motor control section with the function which inputs alternating current power and outputs a drive wave by incorporating the inverter transducer which changes power, and inverter control CPU which controls it into one module can be dealt with now as one component (module). For this reason, the individual separate installation meter of the inverter currently conventionally performed for every motor becomes in general unnecessary, and the design man day of an inverter can be sharply reduced now.
[0008] Moreover, if this motor control module is used, in order to carry out to generation of a drive wave in inverter control CPU in a module, the load concerning Exterior CPU etc. decreases very much. Furthermore, since CPU of dedication is allotted in the module, it excels in high-speed responsibility and control of a motor comes to be stabilized. In addition, as for inverter control CPU, it is desirable to consider as the general-purpose thing which can respond to the motor of a different class. In this case, a motor control module can be used now in the still larger range as components which mitigate the load of the inverter design according to individual.
[0009] The motor control module concerning claim 2 is a motor control module according to claim 1, and is further equipped with the 1st substrate and the 2nd substrate. The inverter transducer has two or more power components. Moreover, what has big calorific value is mounted in the 1st substrate among power components so that the calorific value of the 2nd substrate may become smaller than the calorific value of the 1st substrate. On the other hand, inverter control CPU is mounted in the 2nd substrate. Power components mean components, such as a semiconductor device which can deal with power several W or more, and diode, a fixed resistor.
[0010] He usually mounts in the 1st substrate what has big calorific value among the power components of the inverter transducer accompanied by generation of heat, and is trying for the calorific value of the 2nd substrate to become smaller than the calorific value of the 1st substrate here. And CPU which generally dislikes heat is mounted in the 2nd substrate. It becomes possible to miniaturize the whole module, suppressing the effect of the heat which inverter control CPU in a module receives by this.
[0011] In addition, in the thermal design of this motor control module, if even required airflow is applied, it is desirable for all the components in a module to enable it to acquire the desired cooling effect. The motor control module concerning claim 3 is a motor control module according to claim 2, and the 1st substrate and the 2nd substrate are arranged at the multilayer.
[0012] In the motor control module of claim 2, the 2nd substrate smaller than the 1st substrate is adopted, and standing the 2nd substrate to the 1st substrate, or floating the 2nd substrate by an exclusive pin etc. from the 1st substrate is also considered. On the other hand, in the motor control module of claim 3, the 1st substrate and the 2nd substrate are arranged to the multilayer. Although the inclination for the microcomputer of various functions and many outputs to be needed is strong and is in the inclination for circumference components to also increase in number according to it, in inverter control, since the 1st substrate and the 2nd substrate are arranged to the multilayer, it becomes possible with the motor control module of claim 3 to use many outputs and mass inverter control CPU. Thus, if many outputs and adoption of mass inverter control CPU are attained, since inverter control CPU which can respond to various motors can be incorporated in a module, the motor control module as components can be used by the inverter design of the larger range.
[0013] Moreover, the effectiveness that a floor space (superficial size) required for installation of a motor control module becomes small can also be acquired by multilayer arrangement of two or more substrates. The motor control module concerning claim 4 is a motor control module according to claim 2 or 3, and the 1st substrate is a substrate with thermal conductivity higher than the 2nd substrate. Moreover, bare chip mounting

of the power components mounted in the 1st substrate is carried out by the bonding wire etc. at the 1st substrate.

[0014] Here, the 1st substrate was made [thermally conductive] better than the 2nd substrate, and the configuration which carries out bare chip mounting of the power components at the 1st substrate is taken. For this reason, the heat by generation of heat of power components comes to radiate heat efficiently through the 1st substrate. When using the usual printed circuit board for the 2nd substrate, it is possible to use the substrate which set the aluminum plate by the aluminum substrate, the alumina substrate, and the ceramic plate as the 1st substrate. Such 1st substrate functions as an efficient heat sink.

[0015] In addition, when a radiation fin is prepared in the 1st substrate, higher heat dissipation nature can be obtained. The motor control module concerning claim 5 is a motor control module given in either of claims 1-4, and inverter control CPU has the control network to two or more motors of each.

[0016] Here, since the control network to two or more motors is given to inverter control CPU, correspondence of a motor control module is attained also at the concurrency control of two or more motors. Moreover, the use range of a motor control module becomes large as components which can control the drive of various motors. In addition, since the interior is equipped with inverter control CPU of dedication in the motor control module of this invention, it is easy to make the CPU itself generous and it is possible to give two or more control networks to inverter control CPU.

[0017] Moreover, inverter control CPU means giving the information (information that duty is decided how to compensate for the wave for driving each motor, or a drive command etc.) corresponding to [having two or more control networks] two or more motors of each, into inverter control CPU. The motor control module concerning claim 6 is a motor control module according to claim 5, and the inverter transducer has the converter section and two or more inverter sections. The converter section changes the alternating current power inputted into direct current power. The inverter section changes direct current power into the alternating current power of the frequency of arbitration. Moreover, inverter control CPU controls the converter section and two or more inverter sections, and outputs a drive wave to two or more motors.

[0018] Here, the alternating current power of the frequency suitable for the drive wave by which two or more inverter sections of each were generated to the predetermined motor is generated. Therefore, it is possible to perform concurrency control of two or more motors with the motor control module which is one component. The motor control module concerning claim 7 is a motor control module according to claim 6, and is further equipped with the internal electrical power source. An internal electrical power source is a power source for inverter control CPU, and is generated from the direct current power changed by the alternating current power or the converter section inputted.

[0019] Thus, by incorporating an internal electrical power source in a module, the components which it becomes unnecessary to put the power source of dedication on the modular exterior, and are arranged outside can be reduced. In addition, about the motor control module of invention concerning claim 7, the configuration which carries out the external input of the power source (power) for driving inverter control CPU in a module can also be taken. Also in this case, since it is convertible for desired two or more power sources with an internal electrical power source, the power source inputted from the outside becomes good with a single power source, and the components arranged outside can be reduced.

[0020] The motor control module concerning claim 8 is a motor control module given in either of claims 1-7, and inverter control CPU inputs the command about the operating power of a motor from the outside, and outputs an abnormality signal outside. Here, if the command about the operating power of a motor is inputted by an analog or a digital signal input from the outside by Exterior CPU (external microcomputer) etc., a motor control module will generate a drive wave according to the command, and will output it to a motor. Moreover, when abnormal, an abnormality signal is outputted outside. Thus, in order that a motor control module may perform generation and abnormality distinction of a drive wave, the load concerning Exterior CPU etc. becomes very small, and design man days, such as Exterior CPU, will be greatly reduced compared with the former.

[0021] In addition, when an abnormality signal is outputted from a motor control module, it is thought that Exterior CPU etc. is designed so that the measure according to it may be taken. For example, the main control CPU of a conditioner is Exterior CPU, and if an abnormality signal is outputted from a motor control module to main control CPU when using the motor control module of claim 8 as electronic autoparts which perform drive control of the fan motor of an exterior unit, and a compressor, taking the measure of main control CPU stopping a conditioner will be expected.

[0022] The motor control module concerning claim 9 is a motor control module according to claim 8, and it has the distinction function whether the interior of inverter control CPU is unusual, or the exterior is unusual. Moreover, the abnormality signal outputted outside from inverter control CPU includes the information on whether the interior is unusual or the exterior is unusual. i.e., the information whether abnormalities occurred

externally whether abnormalities occurred inside the motor control module.
[0023] Here, the exterior CPU where an abnormality signal is outputted can acquire now existence of abnormalities and the information of the abnormalities inside a motor control module, or the abnormalities of the motor control-module exterior from a motor control module. Therefore, when Exterior CPU etc. stores those information, pinpointing of the abnormality part at the time of repair of components etc. becomes easy, and can lessen a substitute part.
[0024] The motor control module concerning claim 10 is a motor control module according to claim 9, and inverter control CPU performs protection control which protects the interior, when the interior is unusual, and it outputs the contents of the internal abnormalities outside. Here, in order to perform protection control of internal protection of inverter control CPU at the time of internal abnormalities, the load concerning Exterior CPU etc. decreases more.
[0025] The motor control module concerning claim 11 is a motor control module given in either of claims 1-10, and is further equipped with the electric fan for cooling an inverter transducer and inverter control CPU. Here, since the electric fan of the dedication for cooling the inverter transducer and inverter control CPU in a module is incorporated, as for a motor control module, the degree of freedom of the installation increases. That is, since sufficient cooling effect can be acquired by the electric fan of dedication even if it does not use the wind generated by the external fan etc., it becomes possible to install a motor control module in the location of arbitration.
[0026] The conditioner concerning claim 12 is equipped with at least one fan motor made to rotate an outdoor fan, compressor, and main control CPU and a motor control module given in either of claims 1-11. Main control CPU emits the drive command to a fan motor and a compressor. A motor control module inputs the drive command from main control CPU by inverter control CPU, and outputs the drive wave according to a drive command to a fan motor and a compressor.
[0027] Here, a motor control module outputs the drive wave corresponding the drive command of the fan motor and compressor which are a motor to the drive command to reception, a fan motor, and a compressor from the main control CPU which controls the whole conditioner. And inverter control CPU is included in the interior of a motor control module, and in order that the inverter control CPU may perform generation of a drive wave, the load applied to main control CPU about the drive of a fan motor and a compressor decreases very much. For this reason, the software design of the main control CPU about the inverter control of a fan motor or a compressor is mitigated, and a design man day is reduced sharply.
[0028]
[Embodiment of the Invention] The motor control module applied to 1 operation gestalt of this invention used for drawing 1 with the conditioner in the conditioner concerning 1 operation gestalt of <outline configuration of conditioner> this invention is shown in drawing 2 . The conditioner 1 consists of 4, such as refrigerant piping which connects both 2 and 3 to the interior unit 2 attached indoors and the exterior unit 3 installed in outdoor. A blower fan, indoor heat exchanger, etc. are arranged inside the interior unit 2. Inside the exterior unit 3, the outdoor fan who rotates with a compressor and a fan motor, the outdoor heat exchanger, etc. are arranged. Refrigerant piping connects the indoor heat exchanger in an interior unit 2, and the outdoor heat exchanger in an exterior unit 3, and constitutes the refrigerant circuit with each heat exchanger.
[0029] <Outline control configuration of conditioner> drawing 2 is the block diagram showing the outline of a power circuit in which it is used for a conditioner 1, and is expressed centering on the motor control module 50 which is arranged in an exterior unit 3 and which was elegance-ized the part. The main control CPU 10 prepared in order to control the whole conditioner 1 has ROM and the various interfaces which are not illustrated, receives the detecting signal from sensors 22, controls actuators 21, takes out a rate command to the motor control module 50, and makes the compressor 31-1 and fan motor 31-2 of an exterior unit 3 drive. The heat exchanger thermistor which detects the evaporation temperature and condensation temperature of an open air thermistor and a heat exchanger which detect outside air temperature as sensors 22, the discharge-tube temperature sensor which detects the discharge-tube temperature of a compressor, the discharge-pressure sensor which detects the discharge side and inlet-side pressure of a compressor, a suction pressure sensor, etc. are mentioned. Moreover, the 4 way change-over valve for switching the operation mode of the electric expansion valve for being arranged in a refrigerant circuit and decompressing an internal refrigerant as actuators 21, and a refrigerant circuit etc. is mentioned. In addition, an electric power supply is carried out to main control CPU 10 from the switching power supply (control power source) connected to the commercial alternating current power source.
[0030] The <basic configuration of motor control module> motor control module 50 controls the supply voltage for driving two or more motors 31-1 - 31-n according to the operation situation of a conditioner 1. Specifically in this air conditioning system 1, the motor control module 50 controls the alternating current power which has a

predetermined drive wave for driving the compressor 31-1 and fan motor 31-2 in an exterior unit 3 according to the rate command from main control CPU 10. Although the modularization of this motor control module 50 is carried out so that a part can be dealt with as elegance, it contains CPU53 of dedication in that interior. Specifically, the inside CPU 53 of the converter section 51, two or more inverter sections 52-1 - 52-n, and a module and an internal electrical power source 54 are components-ized as one module.
[0031] The converter section 51 rectifies the alternating current power of the single phase inputted into the motor control module 50, or a three phase, and changes it into a direct current. The converter section 51 can be considered as the configuration which used the power switch, and can also be considered as a configuration including the active filter circuit which outputs a direct current of a fixed electrical potential difference to the inverter section 52-1 - 52-n.
[0032] Two or more inverter sections 52-1 - 52-n change the output (direct current) of the converter section 51 into the alternating current of the frequency of arbitration, and output it to a motor 31-1 - 31-n, respectively. Here, in order to use the motor control module 50 for drive control of a compressor 31-1 and a fan motor 31-2, it has composition in which the inverter section 52-1 outputs alternating current power to a compressor 31-1, and the inverter section 52-2 outputs alternating current power to a fan motor 31-2.
[0033] The inside CPU 53 of a module consists of one chip microcomputers including a microprocessor, ROM, various interfaces, etc. The inside CPU 53 of this module has the control network to two or more motors 31-1 - 31-n. The information that duty is specifically decided how to compensate for the rate command from the drive wave for driving each motor or main control CPU 10 etc. is incorporated in [CPU / 53] the module. Thereby, the inside CPU 53 of a module can generate a drive wave now to a motor 31-1 - 31-n based on the rate command from main control CPU 10. In addition, although the control network corresponding to a compressor 31-1 and a fan motor 31-2 is incorporated in [CPU / 53] the module at least in the motor control module 50 used with an air conditioning system 1, it is also possible to give the control network of two or more kinds of motors (an AC motor, a stepping DC motor, sensor loess DC motor, etc.) to the motor control module 50. With such a module, it also becomes possible to drive to coincidence the motor of a class by which many differ. Moreover, it is not based on the class of motor to be used, but the same components (module) can be used now.

[0034] Moreover, the inside CPU 53 of a module has the abnormality signal output function which outputs the protection feature which protects the interior of a module 50, and an abnormality signal including the contents of the abnormalities outside (main control CPU 10), when the interior of the distinction function of whether the caused abnormalities are internal abnormalities (abnormalities in a module) or to be external abnormalities (abnormalities besides a module) and abnormalities is unusual. Main control CPU 10 receives the abnormality signal outputted out of [CPU / 53] a module, and it takes the measure of stopping a conditioner 1 while it stores abnormality information and gives the facilities in repair of components etc., and exchange.
[0035] An internal electrical power source 54 is an exclusive power source of the sake in [CPU / 53] a module, and is generated from the commercial alternating current power inputted into the motor control module 50.
In the <detail configuration of motor control module> motor control module 50, a controllability is made to improve passive circuit elements accumulation and by carrying out a modularization and package-izing exoergic components and noise-source components, and it makes it possible to make highly efficient control perform.
[0036] As shown in drawing 3 , the printed circuit board (multilayer arrangement was carried out) 62 and the aluminum substrate 61 which have been arranged in parallel up and down are equipped with the electrical part in the motor control module 50. Moreover, wiring of the up-and-down printed circuit board 62 and the aluminum substrate 61 is connected by the cable run plate 63 by which resin mold was carried out. Since the inside CPU 53 of the module which consists of one chip microcomputers including a microprocessor, ROM, various interfaces, etc. is what should be intercepted from generation of heat and the noise by other electrical parts, the printed circuit board 62 which is not equipped with what has big calorific value among the power components 71 is equipped with it. Moreover, the printed circuit board 62 is equipped also with the control-section article without generation of heat (or few).
[0037] On the other hand, in the motor control module 50, bare chip mounting of the power components 71 (what deals with power about tenW or more), such as diode and a power transistor, is altogether carried out at the aluminum substrate 61 among the components which constitute the converter section 51, the inverter section 52-1 - 52-n. Thus, since it constitutes so that bare chip mounting of all the things that have large calorific value may be carried out with the wirebonding wire 73 etc. among the power components 71 at the aluminum substrate 61, the calorific value of a printed circuit board 62 is smaller than the calorific value of the aluminum substrate 61, and the effect of the high heat and noise to the CPU53 grade in a module of a printed circuit board 62 is suppressed.
[0038] In addition, that on which thermal conductivity stuck the sheet metal of the copper which constitutes a

circuit pattern on the front face of the good high alumimium nitride plate of electric insulation is used for the aluminum substrate 61. As mentioned above, finally the aluminum substrate 61 with which bare chip mounting of the power components 71 was carried out on the component side is covered by the mold material 81. The mold material 81 is a wrap about the power components 71 or the components on a bonding wire 73 and the other aluminum substrates 61, as shown in drawing 4 (a). The mold material 81 consists of insulating synthetic resin, such as silicon system resin and resin of an epoxy system. This mold material 81 has the function to which diffusion heat transfer of the heat which the power components 71 emit is carried out, and raises the cooling effect of the motor control module 50. Moreover, by covering power components 71 grade by the mold material 81, the components in a module 50 can be protected now from **** or moisture, and the degree of freedom of arrangement of the motor control module 50 increases. It becomes possible to specifically arrange the motor control module 50 on the ventilation tooth space of the exterior unit 3 with which many moisture and dust exist instead of the inside of the machine room of an exterior unit 3.

[0039] In addition, putting mold material among the power components 71 only at the place of a bonding wire 73 is also considered instead of putting the mold material 81 on the aluminum substrate 61, as shown in drawing 4 (a). Moreover, as shown in drawing 4 (b), it is possible to cover by the mold material 81 not only about the components on the aluminum substrate 61 but about the components on a printed circuit board 62.

[0040] Thus, it is possible by taking wrap structure for the main parts of the motor control module 50 by the mold material 81 to perform the thermal design of the motor control module 50, taking the wind by the outdoor fan of an exterior unit 3 into count. In fact, if even required airflow is applied to a module 50, it succeeds in the thermal design of the motor control module 50 so that all the components in a module 50 may be cooled to the level which does not have trouble in actuation.

[0041] The <control of compressor and fan motor> main control CPU 10 transmits the controlled variable of a compressor 31-1 and a fan motor 31-2 to CPU53 in the motor control module 50 in the form of a rotational-speed command signal while it determines the controlled variable of each part and outputs a control value to actuators 21 according to the detection value inputted from sensors 22, and current operation mode.

[0042] Within [CPU / 53] a module, the drive wave of a compressor 31-1 and a fan motor 31-2 is generated based on the rotational-speed command signal (rate command) transmitted from main control CPU 10. And CPU53 controls the converter section 51 and the inverter section 52-1, and 52-2, and makes the drive wave which suited the rate command from main control CPU 10 output to a compressor 31-1 and a fan motor 31-2. The alternating current power which has a predetermined frequency to a compressor 31-1 and a fan motor 31-2 is supplied from the inverter section 52-1 and 52-2 by this, and a compressor 31-1 and a fan motor 31-2 drive as the rate command of main control CPU 10.

[0043] In the <description of motor control module of this operation gestalt> (1) motor control module 50 By incorporating into one module, the converter section 51 and the inverter section 52-1 - 52-n which change commercial alternating current power into the alternating current power of the frequency of arbitration, and CPU53 which controls them A motor control section with the function which inputs commercial alternating current power and outputs a drive wave can be dealt with now as one component (module). For this reason, the individual separate installation meter of the inverter currently conventionally performed for every motor becomes unnecessary, and the design man day of an inverter can be reduced sharply.

[0044] Moreover, if this motor control module 50 is used, since it has composition performed to generation of a drive wave in [CPU / 53] a module, the load concerning main control CPU 10 decreases very much. Furthermore, since CPU53 of dedication is allotted in the module 50, it excels in high-speed responsibility and control of a motor 31-1 - 31-n comes to be stabilized more.

[0045] (2) In the motor control module 50, mount the main power components 71 (all the power components that can deal with power at least about tenW or more) accompanied by generation of heat in the aluminum substrate 61 which is excellent in heat dissipation nature after taking the multilayer structure of the aluminum substrate 61 and a printed circuit board 62, and mount the CPU53 grade which dislikes heat in a printed circuit board 62. The module 50 whole can be miniaturized this suppressing the effect of the heat which the inside CPU 53 of a module receives. Moreover, what has big calorific value is brought together in the aluminum substrate 61 among the power components 71, and the motor control module 50 has come to be able to perform stable control by arranging components with small calorific value (they being [as opposed to / especially / the property] the high components of temperature dependence) to a printed circuit board 62.

[0046] (3) In a motor control module, the printed circuit board 62 smaller than the aluminum substrate 61 is adopted, and standing a printed circuit board 62 to the aluminum substrate 61, or floating a printed circuit board 62 by a bonding wire etc. from the aluminum substrate 61 is also considered.

[0047] On the other hand, in the motor control module 50 of this operation gestalt, the configuration which arranges the aluminum substrate 61 and a printed circuit board 62 to a multilayer is taken, a printed circuit board

62 can be enlarged, and it is possible to use the inside CPU 53 of large capacity and a various functions module. For this reason, it can be incorporated in the motor control module 50, being able to use as the inside CPU 53 of a module mass and multifunctional CPU which can respond to various motors, and the motor control module 50 as components can use it now in the inverter design of the larger range.

[0048] Moreover, the effectiveness that an area required for installation of the motor control module 50 becomes small has been acquired by multilayer arrangement of two or more substrates 61 and 62.

(4) In the motor control module 50, the configuration which carries out bare chip mounting of the power components 71 at the aluminum substrate 61 is taken by using as the aluminum substrate 61 the substrate with which what has big calorific value is mounted among the power components 71. Since this aluminum substrate 61 functions as an efficient heat sink, the heat by generation of heat of the power components 71 radiates heat efficiently through the aluminum substrate 61.

[0049] (5) In the motor control module 50, since the control network to two or more motors 31-1 - 31-n is given in [CPU / 53] a module, it can respond also to the concurrency control of two or more motors 31-1 - 31-n. Moreover, the use range of the motor control module 50 is wide as components which can control the drive of the various motors 31-1 - 31-n.

[0050] (6) In the motor control module 50, the internal electrical power source 54 is incorporated in the module 50. For this reason, it is unnecessary to put the power source of dedication on the exterior of a module 50, and use is further easy to carry out the motor control module 50 on a design.

(7) If it succeeds in the input of a rate command from main control CPU 10, the motor control module 50 will generate a drive wave according to the command, and will output it to a motor. Moreover, when abnormal, after performing abnormality distinction, an abnormality signal is outputted to main control CPU 10. Thus, in order that the motor control module 50 may perform generation and abnormality distinction of a drive wave, the load concerning main control CPU 10 becomes very small, and the design man day of main control CPU 10 is greatly reduced compared with the former.

[0051] In order to heighten the heat dissipation effectiveness of the operation gestalt >(A) aluminum substrate 61 besides <, it is also possible to take the structure which set up the radiation fin to the rear-face side of the component side of the aluminum substrate 61. In case a radiation fin creates the alumimium nitride plate which constitutes the aluminum substrate 61, it can really be formed in coincidence by molding. Moreover, you may make it fix a radiation fin to the aluminum substrate 61 separately by heat joining, adhesion, etc.

[0052] (B) Although the motors used as a controlled system are a compressor 31-1 and a fan motor 31-2 and being explained supposing the two inverter sections 52-1 and the motor control module 50 which has 52-2 inside, the motor control module which becomes controllable [much more motors] can also be made from the above-mentioned operation gestalt. In this case, while many control networks are inputted in [CPU] a module, the number of the inverter sections (n) will increase.

[0053] For example, when the exterior unit is equipped with two outdoor fans, while putting in the control network about a compressor and two fan motors in [CPU] the module, the three inverter sections will be arranged in a module 50.

(C) Although the internal electrical power source 54 is generated from the alternating current power inputted into the module 50 in the motor control module 50 of the above-mentioned operation gestalt (refer to drawing 2), as shown in drawing 5 , an internal electrical power source 54 is also generable from the power rectified by the direct current by the converter section 51.

[0054] (D) Adding the electric fan for cooling to the motor control module 50 of the above-mentioned operation gestalt further is also considered. If the cooling fan of dedication is built into the motor control module 50, the degree of freedom of the installation of the motor control module 50 will increase. That is, since sufficient cooling effect can be acquired by the electric fan of dedication even if it does not use the wind generated by the external fan etc., it becomes possible to install the motor control module 50 in the location of arbitration.

[0055] (E) Although the aluminum substrate 61 is adopted with the above-mentioned operation gestalt, it can replace with this and the alumina substrate which is excellent in heat dissipation nature similarly, the substrate which set the aluminum plate by the ceramic plate can also be adopted.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The perspective view showing the appearance configuration of the conditioner concerning 1 operation gestalt of this invention.
[Drawing 2] The outline control-block Fig. of the air conditioning system containing a motor control module.
[Drawing 3] The side elevation of a motor control module.
[Drawing 4] (a) Drawing showing wrap mold material for a motor control module. (b) Drawing showing wrap mold material for the motor control module of other operation gestalten.
[Drawing 5] The outline control-block Fig. of the air conditioning system containing the motor control module of other operation gestalten.
[Description of Notations]
1 Conditioner
3 Exterior Unit
10 Main Control CPU
31-1 - 31-n Motor
31-1 Compressor
31-2 Fan Motor
50 Motor Control Module
51 Converter Section
52-1 - 52-n Inverter section
53 Inside CPU of Module
54 Internal Electrical Power Source
61 Aluminum Substrate
62 Printed Circuit Board
71 Power Components

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（Ａ）**　(11)特許出願公開番号
特開2003－143871
（P2003－143871A）
(43)公開日　平成15年５月16日(2003.5.16)

(51)Int.Cl.'	識別記号	ＦＩ		テーマコード"(参考)
Ｈ０２Ｍ　7/48		Ｈ０２Ｍ　7/48	Ｚ	３Ｌ０６０
Ｆ２４Ｆ　5/00		Ｆ２４Ｆ　5/00	Ｓ	５Ｈ００７
11/02	１０２	11/02	１０２Ｗ	

審査請求　未請求　請求項の数12　ＯＬ　（全 11 頁）

(21)出願番号　特願2001－336274(P2001－336274)

(22)出願日　平成13年11月１日(2001.11.1)

(71)出願人　000002853
ダイキン工業株式会社
大阪府大阪市北区中崎西２丁目４番12号
梅田センタービル

(72)発明者　飯田　政和
滋賀県草津市岡本町字大谷1000番地の２
ダイキン工業株式会社滋賀製作所内

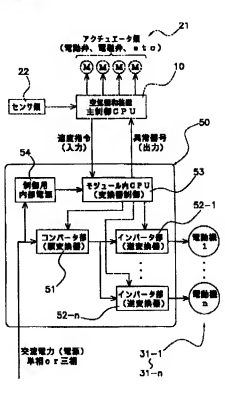
(72)発明者　江平　伸次
滋賀県草津市岡本町字大谷1000番地の２
ダイキン工業株式会社滋賀製作所内

(74)代理人　100094145
弁理士　小野　由己男　（外１名）

最終頁に続く

(54)【発明の名称】　電動機制御モジュールおよびそれを備えた空気調和装置

(57)【要約】
【課題】　電動機ごとに費やされているインバータ設計に対する負荷、すなわちインバータの設計工数を削減することのできる電動機制御モジュールを提供する。
【解決手段】　電動機制御モジュール５０は、交流電力を入力して電動機３１－１～３１－ｎに対し駆動波形を出力するものであって、コンバータ部５１およびインバータ部５２－１～５２－ｎと、モジュール内ＣＰＵ５３とを備えている。コンバータ部５１およびインバータ部５２－１～５２－ｎは、入力される交流電力を任意の周波数の交流電力に変換する。モジュール内ＣＰＵ５３は、電動機３１－１～３１－ｎを駆動するための駆動波形の生成を行い、コンバータ部５１およびインバータ部５２－１～５２－ｎを制御する。



【特許請求の範囲】
【請求項１】交流電力を入力して電動機（３１－１～３１－ｎ）に対し駆動波形を出力する電動機制御モジュール（５０）であって、
入力される交流電力を任意の周波数の交流電力に変換するインバータ変換部（５１，５２－１～５２－ｎ）と、前記駆動波形の生成を行い、前記インバータ変換部（５１，５２－１～５２－ｎ）を制御するインバータ制御ＣＰＵ（５３）と、を備えた電動機制御モジュール（５０）。
【請求項２】第１基板（６１）および第２基板（６２）をさらに備え、
前記インバータ変換部（５１，５２－１～５２－ｎ）は、複数のパワー部品（７１）を有しており、
前記第２基板（６２）の発熱量が前記第１基板（６１）の発熱量よりも小さくなるように、前記パワー部品（７１）のうち発熱量の大きなものは、前記第１基板（６１）に実装され、
前記インバータ制御ＣＰＵ（５３）は、前記第２基板（６２）に実装される、請求項１に記載の電動機制御モジュール（５０）。
【請求項３】前記第１基板（６１）および前記第２基板（６２）は、多層に配置されている、請求項２に記載の電動機制御モジュール（５０）。
【請求項４】前記第１基板（６１）は、前記第２基板（６２）よりも熱伝導性の高い基板であり、
前記第１基板（６１）に実装される前記パワー部品（７１）は、前記第１基板（６１）にペアチップ実装される、請求項２または３に記載の電動機制御モジュール（５０）。
【請求項５】前記インバータ制御ＣＰＵ（５３）は、複数の電動機（３１－１～３１－ｎ）それぞれに対する制御系統を有している、請求項１から４のいずれかに記載の電動機制御モジュール（５０）。
【請求項６】前記インバータ変換部（５１，５２－１～５２－ｎ）は、入力される交流電力を直流電力に変換するコンバータ部（５１）と、前記直流電力を任意の周波数の交流電力に変換する複数のインバータ部（５２－１～５２－ｎ）とを有しており、
前記インバータ制御ＣＰＵ（５３）は、前記コンバータ部（５１）および前記複数のインバータ部（５２－１～５２－ｎ）を制御して、複数の電動機（３１－１～３１－ｎ）に対して駆動波形を出力する、請求項５に記載の電動機制御モジュール（５０）。
【請求項７】入力される交流電力または前記コンバータ部（５１）により変換された直流電力から生成される前記インバータ制御ＣＰＵ（５３）のための内部電源（５４）をさらに備えた、請求項６に記載の電動機制御モジュール（５０）。
【請求項８】前記インバータ制御ＣＰＵ（５３）は、電動機（３１－１～３１－ｎ）の運転出力に関する指令を外部から入力し、異常信号を外部に出力する、請求項１から７のいずれかに記載の電動機制御モジュール（５０）。
【請求項９】前記インバータ制御ＣＰＵ（５３）は、内部異常であるか外部異常であるかの判別機能を有しており、
前記異常信号は、内部異常であるか外部異常であるかの情報を含んでいる、請求項８に記載の電動機制御モジュール（５０）。
【請求項１０】前記インバータ制御ＣＰＵ（５３）は、内部異常であるときに内部を保護する保護制御を行い、
内部異常の内容を外部に出力する、請求項９に記載の電動機制御モジュール（５０）。
【請求項１１】前記インバータ変換部（５１，５２－１～５２－ｎ）および前記インバータ制御ＣＰＵ（５３）を冷却するための電動ファンをさらに備えた、請求項１から１０のいずれかに記載の電動機制御モジュール（５０）。
【請求項１２】室外ファンを回転させる少なくとも１つのファンモータ（３１－２）と、
圧縮機（３１－１）と、
前記ファンモータ（３１－２）および前記圧縮機（３１－１）に対する駆動指令を発する主制御ＣＰＵ（１０）と、
前記主制御ＣＰＵ（１０）からの駆動指令を前記インバータ制御ＣＰＵ（５３）で入力し、前記駆動指令に応じた駆動波形を前記ファンモータ（３１－２）および前記圧縮機（３１－１）に出力する請求項１から１１のいずれかに記載の電動機制御モジュール（５０）と、を備えた空気調和装置（１）。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、電動機制御モジュールおよびそれを備えた空気調和装置、特に、電動機をインバータ制御するための電動機制御モジュールおよびそれを備えた空気調和装置に関する。
【０００２】
【従来の技術】モータ等の電動機を駆動する方法として、最近ではインバータを用いる方法が主流となってきている。インバータは、電動機の動作周波数を自在に制御することによって電動機の出力を調整することができるため、省エネルギーの観点から非常に優位な技術である。このインバータは、電動機を制御・駆動する電動機制御部であり、ＩＧＢＴやＩＰＭといった主回路素子（インバータモジュール）などを含む複数の部品から構成されている。
【０００３】インバータの基本構成としては、商用交流電源を直流に整流するコンバータ部、直流電力を任意の周波数の交流電力に変換するインバータ部、これらの電

力変換部を制御する制御部などが挙げられる。

【０００４】

【発明が解決しようとする課題】インバータは、使用する半導体チップに集中する熱量が多く、制御回路が複雑で細かな部品が数多く使用されることもあって、その設計が非常に困難で時間のかかるものとなっている。このようなインバータの設計に関し、従来においては、対象となる電動機ごとにインバータのハード部分を個別設計している。具体的には、今までのものとは違う電動機に対して、その度、設計者が制御電力、ドライブ回路、主回路などの選定を行っている。また、外部のマイコン等に配されるインバータのソフト部分（インバータ駆動のソフト）についても、電動機ごとに個別設計が行われて専用ソフトが作成され、電動機とのマッチング試験が為されている。

【０００５】さらに、インバータのハード部分の熱設計については、風などを考慮した構造的な設計が絡んでくるため、電動機ごとに多くの技術者を動員して設計開発を行っている。本発明の課題は、電動機ごとに費やされているインバータ設計に対する負荷、すなわちインバータの設計工数を削減することのできる電動機制御モジュールを提供することにある。

【０００６】

【課題を解決するための手段】請求項１に係る電動機制御モジュールは、交流電力を入力して電動機に対し駆動波形を出力するものであって、インバータ変換部と、インバータ制御ＣＰＵとを備えている。インバータ変換部は、入力される交流電力を任意の周波数の交流電力に変換する。インバータ制御ＣＰＵは、電動機を駆動するための駆動波形の生成を行い、インバータ変換部を制御する。

【０００７】ここでは、電力を変換するインバータ変換部とそれを制御するインバータ制御ＣＰＵとを１つのモジュールの中に組み込むことで、交流電力を入力し駆動波形を出力する機能を持つ電動機制御部を１つの部品（モジュール）として取り扱うことができるようになっている。このため、電動機ごとに従来行っているインバータの個別設計が概ね不要となり、インバータの設計工数を大幅に削減することができるようになる。

【０００８】また、この電動機制御モジュールを用いると、モジュール内のインバータ制御ＣＰＵにおいて駆動波形の生成まで行うようになっているため、外部ＣＰＵ等にかかる負荷が非常に少なくなる。さらに、モジュール内に専用のＣＰＵを配しているため、高速応答性に優れており、電動機の制御が安定するようになる。なお、インバータ制御ＣＰＵは、異なる種類の電動機に対応できる汎用的なものとすることが望ましい。この場合には、個別のインバータ設計の負荷を軽減する部品として電動機制御モジュールを更に広い範囲で用いることができるようになる。

【０００９】請求項２に係る電動機制御モジュールは、請求項１に記載の電動機制御モジュールであって、第１基板および第２基板をさらに備えている。インバータ変換部は、複数のパワー部品を有している。また、第２基板の発熱量が第１基板の発熱量よりも小さくなるように、パワー部品のうち発熱量の大きなものは、第１基板に実装されている。一方、インバータ制御ＣＰＵは、第２基板に実装される。パワー部品とは、数Ｗ以上の電力を取り扱える半導体デバイスやダイオード、固定抵抗器などの部品をいう。

【００１０】ここでは、通常発熱を伴うインバータ変換部のパワー部品のうち発熱量の大きなものを第１基板に実装し、第２基板の発熱量が第１基板の発熱量よりも小さくなるようにしている。そして、一般に熱を嫌うＣＰＵを第２基板に実装している。これによって、モジュール内のインバータ制御ＣＰＵが受ける熱の影響を抑えつつ、モジュール全体を小型化することが可能となる。

【００１１】なお、この電動機制御モジュールの熱設計においては、必要な風量さえ当ててやればモジュール内の全ての部品が所望の冷却効果を得られるようにしてやることが望ましい。請求項３に係る電動機制御モジュールは、請求項２に記載の電動機制御モジュールであって、第１基板および第２基板が多層に配置されている。

【００１２】請求項２の電動機制御モジュールにおいて、第１基板よりも小さな第２基板を採用し、第２基板を第１基板に立てたり、第２基板を第１基板から専用ピンなどによって浮かしたりすることも考えられる。これに対し、請求項３の電動機制御モジュールでは、第１基板および第２基板を多層に配置している。インバータ制御では、多機能・多出力のマイコンが必要になる傾向が強く、それに応じて周辺部品も多くなる傾向にあるが、請求項３の電動機制御モジュールでは、第１基板および第２基板を多層に配置しているため、多出力・大容量のインバータ制御ＣＰＵをモジュール内に組み込むことができるようになるため、部品としての電動機制御モジュールをより広い範囲のインバータ設計で用いることができるようになる。

【００１３】また、複数の基板の多層配置によって、電動機制御モジュールの設置に必要な床面積（平面的なサイズ）が小さくなるという効果を得ることもできる。請求項４に係る電動機制御モジュールは、請求項２または３に記載の電動機制御モジュールであって、第１基板は第２基板よりも熱伝導性の高い基板である。また、第１基板に実装されるパワー部品は、第１基板にボンディングワイヤ等によってベアチップ実装される。

【００１４】ここでは、第１基板を第２基板よりも熱伝導性のよいものにして、パワー部品を第１基板にベアチ

ップ実装する構成を採っている。このため、パワー部品の発熱による熱が第１基板を介して効率よく放熱されるようになる。第２基板に通常のプリント基板を使う場合、第１基板として、アルミ基板、アルミナ基板、セラミック板にアルミ板を合わせた基板などを使うことが考えられる。このような第１基板は、効率的な放熱板として機能する。

【００１５】なお、第１基板に放熱フィンを設けた場合には、より高い放熱性を得ることができる。請求項５に係る電動機制御モジュールは、請求項１から４のいずれかに記載の電動機制御モジュールであって、インバータ制御ＣＰＵは、複数の電動機それぞれに対する制御系統を有している。

【００１６】ここでは、複数の電動機に対する制御系統をインバータ制御ＣＰＵに持たせているので、電動機制御モジュールは、複数の電動機の同時制御にも対応が可能となる。また、種々の電動機の駆動を制御できる部品として、電動機制御モジュールの利用範囲が広くなる。なお、本発明の電動機制御モジュールでは、内部に専用のインバータ制御ＣＰＵを備えているため、ＣＰＵ自体を余裕あるものとすることが容易であり、複数の制御系統をインバータ制御ＣＰＵに持たせることが可能となっている。

【００１７】また、インバータ制御ＣＰＵが複数の制御系統を有するとは、インバータ制御ＣＰＵの中に複数の電動機それぞれに対応する情報（それぞれの電動機を駆動するための波形や駆動指令に合わせてデューティをどう決めてやるといった情報など）を持たせることを意味する。請求項６に係る電動機制御モジュールは、請求項５に記載の電動機制御モジュールであって、インバータ変換部は、コンバータ部と、複数のインバータ部とを有している。コンバータ部は、入力される交流電力を直流電力に変換する。インバータ部は、直流電力を任意の周波数の交流電力に変換する。また、インバータ制御ＣＰＵは、コンバータ部および複数のインバータ部を制御して、複数の電動機に対して駆動波形を出力する。

【００１８】ここでは、複数のインバータ部それぞれが、所定の電動機に対して生成された駆動波形に合った周波数の交流電力を発生させる。したがって、１つの部品である電動機制御モジュールによって、複数の電動機の同時制御を行うことが可能である。請求項７に係る電動機制御モジュールは、請求項６に記載の電動機制御モジュールであって、内部電源をさらに備えている。内部電源は、インバータ制御ＣＰＵのための電源であり、入力される交流電力またはコンバータ部により変換された直流電力から生成される。

【００１９】このように内部電源をモジュール内に組み込むことによって、モジュールの外部に専用の電源を置く必要がなくなり、外部に配置される部品を減らすことができる。なお、請求項７に係る発明の電動機制御モジュールについては、モジュール内のインバータ制御ＣＰＵを駆動するための電源（電力）を外部入力する構成を採ることもできる。この場合においても、内部電源により所望の複数電源に変換することができるため、外部から入力される電源は単電源でよくなり、外部に配置する部品を減らすことができる。

【００２０】請求項８に係る電動機制御モジュールは、請求項１から７のいずれかに記載の電動機制御モジュールであって、インバータ制御ＣＰＵは、電動機の運転出力に関する指令を外部から入力し、異常信号を外部に出力する。ここでは、外部ＣＰＵ（外部マイコン）等による外部からのアナログ又はデジタル信号入力などによって電動機の運転出力に関する指令が入力されると、電動機制御モジュールは、その指令に従って駆動波形を生成し電動機に出力する。また、異常があったときには、異常信号を外部に出力する。このように、電動機制御モジュールが駆動波形の生成や異常判別を行うため、外部ＣＰＵ等にかかる負荷は極めて小さくなり、従来に較べて外部ＣＰＵ等の設計工数が大きく削減されることになる。

【００２１】なお、電動機制御モジュールから異常信号が出力されたときには、外部ＣＰＵ等は、それに応じた措置をとるように設計されると考えられる。例えば、空気調和装置の主制御ＣＰＵが外部ＣＰＵであって、室外機のファンモータや圧縮機の駆動制御を行う電装品として請求項８の電動機制御モジュールを用いる場合には、電動機制御モジュールから主制御ＣＰＵに対して異常信号が出力されれば、主制御ＣＰＵは空気調和装置を停止させる等の措置をとることが予想される。

【００２２】請求項９に係る電動機制御モジュールは、請求項８に記載の電動機制御モジュールであって、インバータ制御ＣＰＵは、内部異常であるか外部異常であるかの判別機能を有している。また、インバータ制御ＣＰＵから外部に出力される異常信号は、内部異常であるか外部異常であるかの情報、すなわち電動機制御モジュールの内部で異常が起きたのか外部で異常が起きたのかという情報を含んでいる。

【００２３】ここでは、電動機制御モジュールから異常信号が出力される外部ＣＰＵ等が、異常の存在、および電動機制御モジュール内部の異常か電動機制御モジュール外部の異常かという情報を得ることができるようになる。したがって、外部ＣＰＵ等がそれらの情報を蓄える場合には、部品等の修繕時における異常箇所の特定が容易となり、交換部品を少なくすることができる。

【００２４】請求項１０に係る電動機制御モジュールは、請求項９に記載の電動機制御モジュールであって、インバータ制御ＣＰＵは、内部異常であるときに内部を保護する保護制御を行い、内部異常の内容を外部に出力する。ここでは、内部異常時にインバータ制御ＣＰＵが内部保護の保護制御を行うため、外部ＣＰＵ等にかかる

負荷がより少なくなる。

【００２５】請求項１１に係る電動機制御モジュールは、請求項１から１０のいずれかに記載の電動機制御モジュールであって、インバータ変換部およびインバータ制御ＣＰＵを冷却するための電動ファンをさらに備えている。ここでは、モジュール内のインバータ変換部およびインバータ制御ＣＰＵを冷却するための専用の電動ファンを組み込んでいるため、電動機制御モジュールは、その設置場所の自由度が高まる。すなわち、外部のファン等によって生成される風などを利用しなくても専用の電動ファンによって十分な冷却効果を得ることができるため、電動機制御モジュールを任意の場所に設置することが可能となる。

【００２６】請求項１２に係る空気調和装置は、室外ファンを回転させる少なくとも１つのファンモータと、圧縮機と、主制御ＣＰＵと、請求項１から１１のいずれかに記載の電動機制御モジュールとを備えている。主制御ＣＰＵは、ファンモータおよび圧縮機に対する駆動指令を発する。電動機制御モジュールは、主制御ＣＰＵからの駆動指令をインバータ制御ＣＰＵで入力し、駆動指令に応じた駆動波形をファンモータおよび圧縮機に出力する。

【００２７】ここでは、電動機制御モジュールは、空気調和装置全体の制御を行う主制御ＣＰＵから電動機であるファンモータおよび圧縮機の駆動指令を受け取り、ファンモータおよび圧縮機に対して駆動指令に応じた駆動波形を出力する。そして、電動機制御モジュールの内部にインバータ制御ＣＰＵが組み込まれており、そのインバータ制御ＣＰＵが駆動波形の生成を行うため、ファンモータおよび圧縮機の駆動に関して主制御ＣＰＵにかかる負荷が非常に少なくなる。このため、ファンモータや圧縮機のインバータ制御に関する主制御ＣＰＵのソフト設計が軽減され、設計工数が大幅に削減される。

【００２８】

【発明の実施の形態】＜空気調和装置の概略構成＞本発明の一実施形態に係る空気調和装置を図１に、その空気調和装置で使われる本発明の一実施形態に係る電動機制御モジュールを図２に示す。空気調和装置１は、室内に取り付けられる室内機２と、室外に設置される室外機３と、両者２、３を結ぶ冷媒配管等４とから構成されている。室内機２の内部には、送風ファン、室内熱交換器などが配置されている。室外機３の内部には、圧縮機、ファンモータにより回転する室外ファン、室外熱交換器などが配置されている。冷媒配管は、室内機２内の室内熱交換器と室外機３内の室外熱交換器とを接続し、各熱交換器とともに冷媒回路を構成している。

【００２９】＜空気調和装置の概略制御構成＞図２は、空気調和装置１に用いられる電源回路の概略を示すブロック図であり、室外機３の中に配置される一部品化された電動機制御モジュール５０を中心に表している。空気調和装置１の全体を制御するために設けられている主制御ＣＰＵ１０は、図示しないＲＯＭや各種インターフェイスを有しており、センサ類２２からの検出信号を受信し、アクチュエータ類２１の制御を行い、電動機制御モジュール５０に速度指令を出して室外機３の圧縮機３１－１およびファンモータ３１－２を駆動させる。センサ類２２としては、外気温を検出する外気サーミスタ、熱交換器の蒸発温度および凝縮温度を検出する熱交サーミスタ、圧縮機の吐出管温度を検出する吐出管温度センサ、圧縮機の吐出側や吸入側圧力を検出する吐出圧力センサや吸入圧力センサなどが挙げられる。また、アクチュエータ類２１としては、冷媒回路内に配置された内部の冷媒を減圧するための電動膨張弁、冷媒回路の運転モードを切り換えるための四路切換弁などが挙げられる。なお、主制御ＣＰＵ１０には、商用交流電源に接続されたスイッチング電源（制御電源）から電力供給が行われる。

【００３０】＜電動機制御モジュールの基本構成＞電動機制御モジュール５０は、複数の電動機３１－１～３１－ｎを駆動するための供給電力を、空気調和装置１の運転状況に応じて制御するものである。具体的には、この空気調和装置１において、電動機制御モジュール５０は、室外機３内の圧縮機３１－１およびファンモータ３１－２を駆動するための所定の駆動波形を有する交流電力を、主制御ＣＰＵ１０からの速度指令に応じて制御する。この電動機制御モジュール５０は、一部品として取り扱うことができるようにモジュール化されているものであるが、その内部に専用のＣＰＵ５３を含んでいる。具体的には、コンバータ部５１、複数のインバータ部５２－１～５２－ｎ、モジュール内ＣＰＵ５３、および内部電源５４が１つのモジュールとして部品化されている。

【００３１】コンバータ部５１は、電動機制御モジュール５０に入力される単相あるいは三相の交流電力を整流して直流に変換する。コンバータ部５１は、パワースイッチを用いた構成とすることが可能であり、またインバータ部５２－１～５２－ｎに対して一定電圧の直流を出力するアクティブフィルタ回路を含む構成とすることも可能である。

【００３２】複数のインバータ部５２－１～５２－ｎは、それぞれ、コンバータ部５１の出力（直流）を任意の周波数の交流に変換して電動機３１－１～３１－ｎに出力する。ここでは、電動機制御モジュール５０を圧縮機３１－１およびファンモータ３１－２の駆動制御に用いるため、インバータ部５２－１が圧縮機３１－１に交流電力を出力し、インバータ部５２－２がファンモータ３１－２に交流電力を出力する構成となっている。

【００３３】モジュール内ＣＰＵ５３は、マイクロプロセッサ、ＲＯＭ、各種インターフェイスなどを含むワンチップマイコンで構成される。このモジュール内ＣＰＵ

５３は、複数の電動機３１－１～３１－ｎに対する制御系統を有している。具体的には、それぞれの電動機を駆動するための駆動波形や主制御ＣＰＵ１０からの速度指令に合わせてデューティをどう決めてやるといった情報などが、モジュール内ＣＰＵ５３に組み込まれている。これにより、モジュール内ＣＰＵ５３は、主制御ＣＰＵ１０からの速度指令に基づいて電動機３１－１～３１－ｎに対して駆動波形を生成することができるようになっている。なお、空気調和装置１で使用する電動機制御モジュール５０では少なくとも圧縮機３１－１およびファンモータ３１－２に対応する制御系統がモジュール内ＣＰＵ５３に組み込まれているが、電動機制御モジュール５０に対して複数種類のモータ（ＡＣモータ、ステッピングＤＣモータ、センサレスＤＣモータなど）の制御系統を持たせることも可能である。このようなモジュールであれば、多くの異なる種類のモータを同時に駆動することも可能となる。また、使用するモータの種類によらず、同じ部品（モジュール）が使えるようになる。

【００３４】また、モジュール内ＣＰＵ５３は、発生した異常が内部異常（モジュール内の異常）であるか外部異常（モジュール外の異常）であるかの判別機能、異常が内部異常であるときにモジュール５０の内部を保護する保護機能、および異常の内容を含む異常信号を外部（主制御ＣＰＵ１０）に出力する異常信号出力機能を有している。主制御ＣＰＵ１０は、モジュール内ＣＰＵ５３から出力される異常信号を受信し、異常情報を蓄えて部品等の修繕、交換における便宜を図るとともに、空気調和装置１を停止させる等の措置をとる。

【００３５】内部電源５４は、モジュール内ＣＰＵ５３のための専用電源であり、電動機制御モジュール５０に入力される商用交流電力から生成される。

＜電動機制御モジュールの詳細構成＞電動機制御モジュール５０では、回路部品を集積・モジュール化し、発熱部品やノイズ源部品をパッケージ化することにより、制御性を改善させ、高機能な制御を行わせることを可能にしている。

【００３６】図３に示すように、電動機制御モジュール５０内の電気部品は、上下に平行に配置された（多層配置された）プリント基板６２およびアルミ基板６１に装着されている。また、上下のプリント基板６２およびアルミ基板６１の配線は、樹脂モールドされた電路板６３によって接続される。マイクロプロセッサ、ＲＯＭ、各種インターフェイスなどを含むワンチップマイコンで構成されるモジュール内ＣＰＵ５３は、他の電気部品による発熱やノイズから遮断すべきものであるため、パワー部品７１のうち発熱量の大きなものが装着されないプリント基板６２に装着されている。また、発熱のない（または少ない）制御部品も、プリント基板６２に装着されている。

【００３７】一方、電動機制御モジュール５０では、コンバータ部５１やインバータ部５２－１～５２－ｎを構成する部品のうちダイオードやパワートランジスタなどのパワー部品７１（十数ワット以上の電力を取り扱うもの）は、全てアルミ基板６１にベアチップ実装されている。このように、パワー部品７１のうち発熱量が大きいもの全てをアルミ基板６１にワイヤボンディングワイヤ７３などによってベアチップ実装するように構成しているため、プリント基板６２の発熱量がアルミ基板６１の発熱量よりも小さくなっており、プリント基板６２のモジュール内ＣＰＵ５３等に対する高い熱やノイズの影響が抑えられる。

【００３８】なお、アルミ基板６１は、熱伝導率が高く電気絶縁性の良好な窒化アルミニウム板の表面に回路パターンを構成する銅の薄板を貼り合わせたものを採用している。以上のように、実装面上にパワー部品７１がベアチップ実装されたアルミ基板６１は、最終的にモールド材８１で覆われる。モールド材８１は、図４（ａ）に示すように、パワー部品７１やボンディングワイヤ７３、その他のアルミ基板６１上の部品を覆う。モールド材８１は、シリコン系樹脂やエポキシ系の樹脂といった絶縁性の合成樹脂で構成されている。このモールド材８１は、パワー部品７１が発する熱を拡散伝熱させる機能を有しており、電動機制御モジュール５０の冷却効果を向上させる。また、モールド材８１でパワー部品７１等を覆うことによって、モジュール５０内の部品を塵害や水分から保護することができるようになり、電動機制御モジュール５０の配置の自由度が増す。具体的には、電動機制御モジュール５０を、室外機３の機械室の中ではなく、水分や塵が多く存在する室外機３の通風スペースに配することが可能になる。

【００３９】なお、図４（ａ）に示すようにモールド材８１をアルミ基板６１に被せる代わりに、パワー部品７１のうちボンディングワイヤ７３のところだけにモールド材を被せることも考えられる。また、図４（ｂ）に示すように、アルミ基板６１上の部品だけではなくプリント基板６２上の部品についてもモールド材８１で覆ってしまうことが考えられる。

【００４０】このように、電動機制御モジュール５０の主要部品をモールド材８１で覆う構造を採ることにより、室外機３の室外ファンによる風を計算に入れて電動機制御モジュール５０の熱設計を行うことが可能である。実際には、電動機制御モジュール５０の熱設計は、必要な風量さえモジュール５０に当ててやればモジュール５０内の全ての部品が作動に支障のないレベルまで冷却されるように為されている。

【００４１】＜圧縮機、ファンモータの制御＞主制御ＣＰＵ１０は、センサ類２２から入力される検出値と現在の運転モードに応じて、各部の制御量を決定し、アクチュエータ類２１に制御値を出力するとともに、圧縮機３１－１、ファンモータ３１－２の制御量を回転速度指令

信号の形で電動機制御モジュール５０内のＣＰＵ５３に送信する。

【００４２】モジュール内ＣＰＵ５３では、主制御ＣＰＵ１０から送信されてきた回転速度指令信号（速度指令）に基づき、圧縮機３１－１およびファンモータ３１－２の駆動波形を生成する。そして、ＣＰＵ５３は、コンバータ部５１およびインバータ部５２－１，５２－２を制御して、圧縮機３１－１およびファンモータ３１－２に対して、主制御ＣＰＵ１０からの速度指令に合った駆動波形を出力させる。これにより、インバータ部５２－１，５２－２から圧縮機３１－１およびファンモータ３１－２に対して所定の周波数を持つ交流電力が供給され、主制御ＣＰＵ１０の速度指令どおりに圧縮機３１－１およびファンモータ３１－２が駆動する。

【００４３】＜本実施形態の電動機制御モジュールの特徴＞

（１）電動機制御モジュール５０では、商用交流電力を任意の周波数の交流電力に変換するコンバータ部５１およびインバータ部５２－１～５２－ｎとそれらを制御するＣＰＵ５３とを１つのモジュールの中に組み込むことで、商用交流電力を入力し駆動波形を出力する機能を持つ電動機制御部を１つの部品（モジュール）として取り扱うことができるようになっている。このため、電動機ごとに従来行っているインバータの個別設計が不要となり、インバータの設計工数を大幅に削減することができる。

【００４４】また、この電動機制御モジュール５０を用いると、モジュール内ＣＰＵ５３において駆動波形の生成まで行う構成となっているため、主制御ＣＰＵ１０にかかる負荷が非常に少なくなる。さらに、モジュール５０内に専用のＣＰＵ５３を配しているため、高速応答性に優れており、電動機３１－１～３１－ｎの制御がより安定するようになる。

【００４５】（２）電動機制御モジュール５０では、アルミ基板６１とプリント基板６２との多層構造を採った上で、発熱を伴う主要なパワー部品７１（少なくとも十数ワット以上の電力を取り扱うことのできるパワー部品の全て）を放熱性に優れるアルミ基板６１に実装し、熱を嫌うＣＰＵ５３等をプリント基板６２に実装している。これにより、モジュール内ＣＰＵ５３が受ける熱の影響を抑えつつモジュール５０全体を小型化することができている。また、パワー部品７１のうち発熱量の大きなものをアルミ基板６１に集め、プリント基板６２に発熱量の小さな部品（特に、その特性に対して温度依存性の高い部品）を配置することで、電動機制御モジュール５０は安定した制御ができるようになっている。

【００４６】（３）電動機制御モジュールにおいては、アルミ基板６１よりも小さなプリント基板６２を採用し、プリント基板６２をアルミ基板６１に立てたり、プリント基板６２をアルミ基板６１からボンディングワイヤなどによって浮かしたりすることも考えられる。

【００４７】これに対し、本実施形態の電動機制御モジュール５０では、アルミ基板６１およびプリント基板６２を多層に配置する構成を採っており、プリント基板６２を大きくすることができ、大容量・多機能なモジュール内ＣＰＵ５３を用いることが可能になっている。このため、種々の電動機に対応することのできる大容量・多機能のＣＰＵをモジュール内ＣＰＵ５３として電動機制御モジュール５０内に組み込むことができ、部品としての電動機制御モジュール５０がより広い範囲のインバータ設計において用いることができるようになっている。

【００４８】また、複数の基板６１，６２の多層配置によって、電動機制御モジュール５０の設置に必要な面積が小さくなるという効果を得られている。

（４）電動機制御モジュール５０では、パワー部品７１のうち発熱量の大きなものが実装される基板をアルミ基板６１として、パワー部品７１をアルミ基板６１にベアチップ実装する構成を採っている。このアルミ基板６１が効率的な放熱板として機能するため、パワー部品７１の発熱による熱がアルミ基板６１を介して効率よく放熱されるようになっている。

【００４９】（５）電動機制御モジュール５０では、複数の電動機３１－１～３１－ｎに対する制御系統をモジュール内ＣＰＵ５３に持たせるので、複数の電動機３１－１～３１－ｎの同時制御にも対応が可能である。また、種々の電動機３１－１～３１－ｎの駆動を制御できる部品として、電動機制御モジュール５０の利用範囲は広い。

【００５０】（６）電動機制御モジュール５０では、内部電源５４をモジュール５０内に組み込んでいる。このため、モジュール５０の外部に専用の電源を置く必要がなくなっており、電動機制御モジュール５０は設計上さらに利用がし易くなっている。

（７）電動機制御モジュール５０は、主制御ＣＰＵ１０からの速度指令の入力が為されると、その指令に従って駆動波形を生成し電動機に出力する。また、異常があったときには、異常判別を行った上で異常信号を主制御ＣＰＵ１０に出力する。このように、電動機制御モジュール５０が駆動波形の生成や異常判別を行うため、主制御ＣＰＵ１０にかかる負荷は極めて小さくなり、従来に較べて主制御ＣＰＵ１０の設計工数が大きく削減される。

【００５１】＜他の実施形態＞

（Ａ）アルミ基板６１の放熱効果を高めるためには、アルミ基板６１の実装面の裏面側に放熱フィンを立設した構造を採ることも可能である。放熱フィンは、アルミ基板６１を構成する窒化アルミニウム板を作成する際に、同時に一体成型で形成することが可能である。また、熱溶着や接着などにより、放熱フィンを別途アルミ基板６１に固着するようにしてもよい。

【００５２】（Ｂ）上記実施形態では、制御対象となる

電動機が圧縮機３１－１およびファンモータ３１－２であり、２つのインバータ部５２－１，５２－２を内部に有する電動機制御モジュール５０を想定して説明を行っているが、さらに多くの電動機の制御が可能となる電動機制御モジュールを作ることもできる。この場合には、モジュール内ＣＰＵに多くの制御系統がインプットされるとともに、インバータ部の数（ｎ）が増えることになる。

【００５３】例えば、室外機が２つの室外ファンを備えているような場合には、圧縮機と２つのファンモータに関する制御系統をモジュール内ＣＰＵに入れておくとともに、３つのインバータ部をモジュール５０内に配備することになる。

（Ｃ）上記実施形態の電動機制御モジュール５０では、モジュール５０に入力された交流電力から内部電源５４を生成しているが（図２参照）、図５に示すように、内部電源５４をコンバータ部５１によって直流に整流された電力から生成することもできる。

【００５４】（Ｄ）上記実施形態の電動機制御モジュール５０に、冷却のための電動ファンをさらに付加することも考えられる。電動機制御モジュール５０に専用の冷却ファンを組み込めば、電動機制御モジュール５０の設置場所の自由度が高まる。すなわち、外部のファン等によって生成される風などを利用しなくても専用の電動ファンによって十分な冷却効果を得ることができるため、電動機制御モジュール５０を任意の場所に設置することが可能となる。

【００５５】（Ｅ）上記実施形態ではアルミ基板６１を採用しているが、これに代えて、同様に放熱性に優れるアルミナ基板やセラミック板にアルミ板を合わせた基板などを採用することもできる。

【００５６】

【発明の効果】請求項１に係る電動機制御モジュールでは、電力を変換するインバータ変換部とそれを制御するインバータ制御ＣＰＵとを１つのモジュールの中に組み込むことで、交流電力を入力し駆動波形を出力する機能を持つ電動機制御部を１つの部品（モジュール）として取り扱うことができるようになっているため、電動機ごとに従来行っているインバータの個別設計が概ね不要となり、インバータの設計工数を大幅に削減することができるようになる。

【００５７】また、この電動機制御モジュールを用いると、モジュール内のインバータ制御ＣＰＵにおいて駆動波形の生成まで行うようになっているため、外部ＣＰＵ等にかかる負荷が非常に少なくなる。さらに、モジュール内に専用のＣＰＵを配しているため、高速応答性に優れており、電動機の制御が安定するようになる。請求項２に係る電動機制御モジュールでは、通常発熱を伴うインバータ変換部のパワー部品のうち発熱量の大きなものを第１基板に実装し、第２基板の発熱量が第１基板の発熱量よりも小さくなるようにしている。そして、一般に熱を嫌うＣＰＵを第２基板に実装している。これによって、モジュール内のインバータ制御ＣＰＵが受ける熱の影響を抑えつつ、モジュール全体を小型化することが可能となる。

【００５８】請求項３に係る電動機制御モジュールでは、多出力・大容量のインバータ制御ＣＰＵの採用が可能になり、種々の電動機に対応することのできるインバータ制御ＣＰＵをモジュール内に組み込むことができるようになるため、部品としての電動機制御モジュールをより広い範囲のインバータ設計で用いることができるようになる。また、複数の基板の多層配置によって、電動機制御モジュールの設置に必要な面積が小さくなるという効果を得ることもできる。

【００５９】請求項４に係る電動機制御モジュールでは、第１基板を第２基板よりも熱伝導性のよいものにして、パワー部品を第１基板にベアチップ実装する構成を採っているため、パワー部品の発熱による熱が第１基板を介して効率よく放熱されるようになる。請求項５に係る電動機制御モジュールでは、複数の電動機に対する制御系統をインバータ制御ＣＰＵに持たせているので、電動機制御モジュールは、複数の電動機の同時制御にも対応が可能となる。また、種々の電動機の駆動を制御できる部品として、電動機制御モジュールの利用範囲が広くなる。

【００６０】請求項６に係る電動機制御モジュールでは、複数のインバータ部それぞれが所定の電動機に対して生成された駆動波形に合った周波数の交流電力を発生させるため、１つの部品である電動機制御モジュールによって複数の電動機の同時制御を行うことが可能である。請求項７に係る電動機制御モジュールでは、内部電源をモジュール内に組み込むことによって、モジュールの外部に専用の電源を置く必要がなくなり、外部に配置される部品を減らすことができる。

【００６１】請求項８に係る電動機制御モジュールでは、電動機制御モジュールが駆動波形の生成や異常判別を行うため、外部ＣＰＵ等にかかる負荷は極めて小さくなり、従来に較べて外部ＣＰＵ等の設計工数が大きく削減されることになる。請求項９に係る電動機制御モジュールでは、電動機制御モジュールから異常信号が出力される外部ＣＰＵ等が、異常の存在、および電動機制御モジュール内部の異常か電動機制御モジュール外部の異常かという情報を得ることができるようになる。したがって、外部ＣＰＵ等がそれらの情報を蓄える場合には、部品等の修繕時における異常箇所の特定が容易となり、交換部品を少なくすることができる。

【００６２】請求項１０に係る電動機制御モジュールでは、内部異常時にインバータ制御ＣＰＵが内部保護の保護制御を行うため、外部ＣＰＵ等にかかる負荷がより少なくなる。請求項１１に係る電動機制御モジュールで

は、モジュール内のインバータ変換部およびインバータ制御ＣＰＵを冷却するための専用の電動ファンを組み込んでいるため、電動機制御モジュールは、その設置場所の自由度が高まる。

【００６３】請求項１２に係る空気調和装置では、電動機制御モジュールは、空気調和装置全体の制御を行う主制御ＣＰＵから電動機であるファンモータおよび圧縮機の駆動指令を受け取り、ファンモータおよび圧縮機に対して駆動指令に応じた駆動波形を出力する。そして、電動機制御モジュールの内部にインバータ制御ＣＰＵが組み込まれており、そのインバータ制御ＣＰＵが駆動波形の生成を行うため、ファンモータおよび圧縮機の駆動に関して主制御ＣＰＵにかかる負荷が非常に少なくなる。このため、ファンモータや圧縮機のインバータ制御に関する主制御ＣＰＵのソフト設計が軽減され、設計工数が大幅に削減される。

【図面の簡単な説明】

【図１】本発明の一実施形態に係る空気調和装置の外観構成を示す斜視図。

【図２】電動機制御モジュールを含む空気調和装置の概略制御ブロック図。

【図３】電動機制御モジュールの側面図。

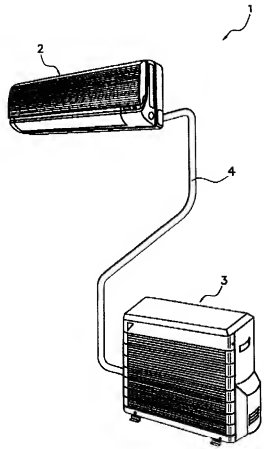
【図４】（ａ）電動機制御モジュールを覆うモールド材を示す図。（ｂ）他の実施形態の電動機制御モジュールを覆うモールド材を示す図。

【図５】他の実施形態の電動機制御モジュールを含む空気調和装置の概略制御ブロック図。

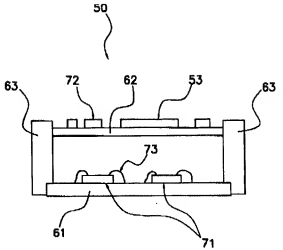
【符号の説明】

１　　空気調和装置
３　　室外機
１０　　主制御ＣＰＵ
３１－１～３１－ｎ　　電動機
３１－１　　圧縮機
３１－２　　ファンモータ
５０　　電動機制御モジュール
５１　　コンバータ部
５２－１～５２－ｎ　　インバータ部
５３　　モジュール内ＣＰＵ
５４　　内部電源
６１　　アルミ基板
６２　　プリント基板
７１　　パワー部品

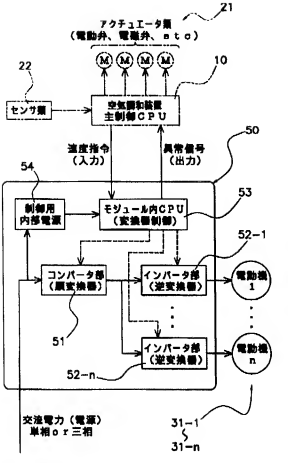
【図１】



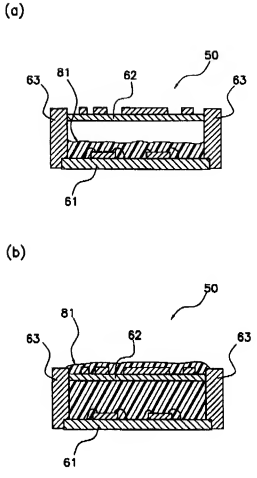
【図３】



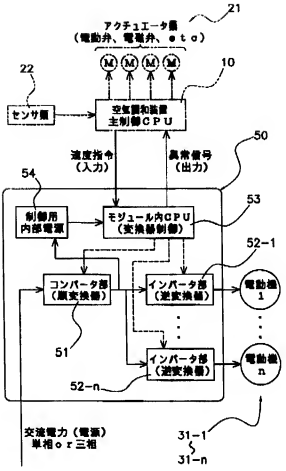
【図２】


21
アクチュエータ類
（電動弁、電磁弁、ａｔｃ）
22
センサ類
10
空気調和装置
主制御ＣＰＵ
速度指令
（入力）
異常信号
（出力）
50
54
制御用
内部電源
モジュール内ＣＰＵ
（変換器制御）
53
52−1
コンバータ部
（順変換器）
インバータ部
（逆変換器）
電動機
1
51
インバータ部
（逆変換器）
電動機
n
52−n
交流電力（電源）
単相ｏｒ三相
31−1
31−n

【図４】


(a)
50
63
81
62
63
61
(b)
50
81
63
62
63
61

【図５】



フロントページの続き

Ｆターム(参考)　3L060 AA03 AA08 CC03 CC04 CC16
　　CC19 DD02 EE04
　　5H007 BB06 CB02 CC07 DB09 HA03
　　HA04